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THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LIII.—No. 6. Whole No. 792. | NEW YORK, MONDAY, AUGUST 11, 1890. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, N.Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told..... 181

The Triumph Heat and Light Company—Public Lighting, Milwaukee, Wis.—Failure of the Fuel Gas Scheme in St. Louis—An English View Respecting the Dual Supply.

The Market for Gas Securities..... 182

Lighthouses and Their Illuminants, by Mr. Wm. Mooney..... 183

Modern Conceptions of Electricity, by Dr. Louis Duncan..... 185

Gas Mains and Joints..... 187

*Hearne's Improvement in Purifying Boxes..... 188

Shall Gas Undertakings Supply Electricity? Yes; by Mr. Arthur F. Guy..... 189

Transportation of Crude Petroleum in the United States..... 189

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 191

The Marietta (O.) Public Lighting Station—Increased Rates for Incandescent Electric Lighting, New Bedford, Mass.—Hints from Pawtucket, R. I.—Gordon Lamps at Bayonne, N. J.—Improvements at Oakland, Cal.—Investigating the Cincinnati (O.) Company—Public Lighting, St. Louis, Mo.—Sale of the Annapolis (Md.) Works—English Gas Coal Rates—A Line from Observer—Resignation of Mr. Ralph Woodward—Public Lighting, Memphis, Tenn.—Annual Meeting, Northampton, Mass.—Declared Null and Void—Pipe Sizes, for Domestic Gas Distribution—And Many Other Items.

BRIEFLY TOLD.

THE TRIUMPH HEAT AND LIGHT COMPANY.—At last we are out of the darkness and into the light, the transition having been made via New Bedford, Mass., which town always had something more or less to do with illuminating materials. The sperm oil days, however, no longer hold sway, and the conflict is confined to kerosene oil, gas and electricity, with the middle-named one of the three having a fairly good lead in pub'ic favor. Now every gas man knows that there are gas processes without number, and that, through the persistency of inventor cranks and the facileness of the Patent Office, we are to have them in still greater profusion. Each crank outclaims his predecessor, and it is little short of wonderful the ingenuity with which the latest comer finds something new to make boast of. To come back to New Bedford, however, with its wondrous new "Company," we are informed that "on the forenoon" of July 31st the Peoples non-Explosive and Sanitary Gas Company was organized "at the office of the Triumph Heat and Light Company," which has for some time back had a resting place in the "Whaling City." The "non-Explosive's" officers are: President, Francis C. Smith; Treasurer, Charles F. Borden; Attorney, Hosea M. Knowlton—the only addition that we could suggest to this list, seeing that the Company appears to be able to get along without a Secretary, and must have an attorney, is that a surgeon, or at least a physician, would be suitable, in that the Company is not only non-explosive but lays claim to sanativeness. And in connection with its title we have a dark suspicion that its organizers were misled in their application of the word sanitary, in that the latter has been confounded by them with sanatory. We are led to this belief from one of their assertions that their "gas is pronounced by physicians to be non-injurious to the health, and can be inhaled with great benefit by persons suffering with throat or lung trouble." Further, that "one gentleman, by allowing the gas daily for three weeks to flow into an eye over which a cataract was forming, had his eyesight *nearly* restored." And here we may be pardoned for remarking that that gentleman must have had peculiar visual organs. The Company has been capitalized in $250,000, and moneyed men are invited to come forward and absorb the "good thing." Premising the particulars of this invitation—which embodies the reasons why capitalists should at once take hold of the affair—with the statement that the process is that "discovered by General Eugene de Beauharnais," the "touters" of the concern say: "The General has been working on the gas for a number of years, but the plant established in this city (New Bedford) is the first complete one for its manufacture that has yet been built. The ingredients of the gas are oil, air and water; one barrel of crude petroleum to 10,000 cubic feet of air and a *very little water*. The gas can be manufactured at a small expense, and can be profitably sold to consumers at a price not exceeding 75 cents per 1,000. Pipes for the distribution of the gas throughout a city can be laid a few inches below the surface of the ground, as neither frost nor heat will affect it in the least. But one of the great features claimed for the gas is its compressibility. Twenty cubic feet can be compressed into one, in portable tanks, which can be placed in stores or houses where the gas is to be used." There is much more in the "claims" that could be counted on to afford amusing reading, but we think the above is sufficient to show

the superb value of the process basis on which the "non-Explosive and Sanitary, etc., Company" rests. The Beauharnais process, which is nothing more than one of the many valueless systems for producing air gas, was exploited in this vicinity with much zeal some years ago—a notable failure of it, for instance, was recorded at Staten Island—has nothing to recommend it in any sense, and we do not suppose those who put money in the attempt to make it "go" in New Bedford will be long in arriving at a similar conclusion.

PUBLIC LIGHTING, MILWAUKEE, WIS.—The local authorities and the Milwaukee Gas Company have agreed upon the terms of a public lighting contract, that is to run for 1 year. The rates are: Each lamp fitted with a 6-foot burner to be charged for at the rate of $27.60 per annum; those fitted with 5-foot burners to cost $24.17 per annum. Gas for public buildings is to cost 90 cents per 1,000 cubic feet. It is also stipulated that at no time during the contract shall there be a less number of street and bridge lamps in use than 1,800. Another provision of the contract is: The Common Council of said city may from time to time during the term of this contract direct the Gas Light Company to extend its mains for a distance in the aggregate not to exceed 3 miles; provided the Council directs the Company to erect and light at least 2 lamps at each street crossing reached by the new lines; and that at least 2 new lamps be ordered for each 500 feet of new mains laid by the Company. All lights are to be lighted by 60 minutes after sundown, and the extinguishing is not to begin prior to 1 hour and 20 minutes of sunrise.

FAILURE OF THE FUEL GAS SCHEME IN ST. LOUIS.—Some time ago we announced that President McMillin, of the Laclede Gas Company, of St. Louis, had determined to try the experiment, on a large scale, of distributing fuel gas in that city, and the results were eagerly looked forward to. In the first place, Mr. McMillin was very well placed for trying the experiment, in that his Company had acquired by purchase the plant and mains of the Water Gas Company, and further, he was as well up in the theory and practice of fuel gas supply as any other man in the country. It was intended to supply a non-carbureted water gas at a very low rate, and the scheme was to have been initiated on July 1st. The supply was in reality begun on July 14th, only to be discontinued on the 31st of the same month. But 16 applications were received, and the outlook was so unsatisfactory that the proprietors determined to end an attempt that promised nothing but disaster. The failure at Louisville, where the initial conditions were quite similar to those at St. Louis, followed so closely by a like ending at the latter place, only emphasizes the position taken by the JOURNAL in respect to the problem of a fuel gas supply. We have always believed that its solution lies in an intelligent use of illuminating gas both for lighting and cooking purposes.

AN ENGLISH VIEW RESPECTING THE DUAL SUPPLY.—The following interesting lines are taken from the inaugural address of the President (Mr. S. Stewart, Greenock) of the North British Association of Gas Managers, at the Perth meeting of that body, on July 24th:

Having submitted such observations upon gas manufacture as I thought might serve to interest the members of the Association, I have deemed it desirable to close my remarks with a short reference to a competitor in the field of illuminants—namely, electric lighting, which has excited considerable interest for some years past, and still continues to do so. It will be admitted that the electric light is an active competitor not to be ignored, but deserving of earnest attention. Mr. Blair, of Tillicoultry, was kind enough to offer the sum of £10 for prizes for the best papers on the subject of gas works supplying the electric light; but unfortunately there has been no response to his offer. Having had the experience of supplying a section of Greenock with the electric light for a couple of years, I am able to speak somewhat confidently of the possible results of a gas works furnishing electric lighting. In Greenock, I may explain, we fitted up two dynamos, each equal to 100 incandescent lamps of 20 candle power, and they were driven by a turbine water wheel and gearing. Only one dynamo was run at a time, but both could have been worked if there had been a demand for the light. The plant was erected on ground belonging to the Water Trust some two miles from gas works; and it was complete in all respects and provided with necessary testing apparatus. Some 25 incandescent lamps were employed in the streets—being put into the ordinary gas lanterns; and part of a sugar refinery was fitted up with 85 incandescent and 2 arc lamps. The whole of the mains and cables were carefully laid under skilled supervision and worked with entire satisfaction. During summer only one man was employed; but in the winter months another was taken on during the daytime, renewing and repairing the lamps, etc. Something like 1,000 yards of cable and 2,500 yards of wires were laid, including branch services to lamps, all put underground. The wires were double lead-covered, having high insulation, safety fuses and distributing boxes. The district lighted outside the Water Trust ground was about 300 yards long by 100 yards wide. The total outlay on plant was £1,630; wages and working expenses came to about £150 per annum, exclusive of interest, depreciation, cost of supervision and power. Had these been included, as in the case of gas supply, the expenditure would have been three times this amount. The sugar refinery was fitted up by the proprietor at a cost of upwards of £200 for the 85 incandescent and the 2 arc lamps. They paid the Gas Trust about £100 per annum for the supply of electricity, and 10s. per week to a man for looking after their lights. The expenses for one year, as estimated by the proprietor—including 5 per cent. on the outlay for wires and lamps, the renewal of the lamps and carbons, the payment to the Gas Trust, wages, etc.—amounted to £175, while their gas account for the portion of refinery lighted by electricity came to about £125. Finding, after a second year's experience, that their expenses were increasing, they decided to give it up and return to gas lighting. The Greenock Police Board, objecting to go on incurring an annual outlay for the few remaining lamps, stopped the experiment. If they could have induced parties to fit up a number of lamps equal to the full power of the dynamos and plant, their yearly expenditure would not have been proportionately increased; that is to say, supposing consumers fitted up the plant within their premises, and maintained it and attended to the renewal of the lamps. It is evident that the electric light cannot be supplied at anything like the cost of gas. Gas is the light of all classes of consumers; but the electric light, from its excessive cost, can only be the luxury of the rich. As to the advisability of gas companies furnishing the electric light, it must be borne in mind that, from the expensive nature of the plant required, the capital necessary to supply a whole town would be so great as to prevent this being done; and all that an electric light company would do would be to select those parts of a town where there were shopkeepers willing to use it for advertising purposes, or whose stocks were such as would be injured by the products of combustion or the heat of gas, or where there were wealthy people willing to have the light for the novelty of the thing. Where gas is sold as cheaply as it is in most towns, there is no risk of the general adoption of the electric light. The introduction of the light must be so gradual that the natural increase in the consumption of gas which takes place in most towns would prevent its effect on the demand for the older illuminant being injuriously felt. There is no part of a gas works plant that can be utilized for the production or supply of electricity. The cost of laying cables from a gas works to the locality proposed to be supplied would, in most cases, be so large that it would be necessary to erect plant in the immediate neighborhood of the district. If a gas company were to take in hand the supply of the electric light it would necessitate putting capital into a new business having special plant and skilled labor and supervision entirely different from a gas business. In order to make it pay, active competition with the gas business would be needed; and one need hardly add that this can scarcely be done by those who find it requires all their energies to make gas works pay, and at the same time provide a cheap and efficient light. In my opinion, the supply of electricity should be left in the hands of those companies who specially take in hand such work, and gas companies should no more trouble themselves with it than they would with the supply of oil to those who prefer to burn this illuminant instead of gas—oil being a much more active competitor than electricity.

WE are called upon to announce the death of Mr. W. W. Cook, of the Butte (Montana) Gas Light and Coke Company. His demise occurred at his home in that city, on the morning of the first inst.

The Market for Gas Securities.

The market for gas shares, particularly in respect to city stock, is absolutely featureless, and what little is being done is confined to room traders. Consolidated is fairly steady at about par, although early in the week some sales were recorded at 99⅜ to ½. To-day (Friday) transactions were reported at the opening at 100, and that figure was afterwards freely bid. Other city shares show no change. Brooklyn stocks are stronger and higher, although to us it seems as if maximum values in them had already been reached. Bay State gas is at 85 to 86, and will go higher. Chicago Trusts are at 53½. The Wilmington (Del.) Company, through Treasurer Taylor, announces a 3 per cent. dividend, payable on demand. Laclede common is lower, at 18½ to 20, while the preferred is also weaker.

[Condensed from "The Modern Lighthouse Service," by Mr. Arnold Burgess Johnson, chief clerk, U. S. Lighthouse Board.]

Lighthouses and Their Illuminants.

By Mr. William Mooney.

The means by which the waters of our coasts, bays, rivers, etc., are safely navigated by day and night, through fogs, storm and sunlight, are very little thought of by the average landsman. The arriving or departing traveler, as from the deck of the ship he views the numerous twinkling and flashing lights which dot the shore, or the lightship which marks the grave of some ill-fated vessel, gives only a passing thought to the usefulness of these aids to navigation.

The necessity for these guides is, however, brought forcibly to his notice when a dense fog settles around his vessel, shutting out of sight everything beyond his immediate vicinity, and he notes the anxiety with which the officers look for the friendly lights or beacons which shall show them their position, and also locate the rocks and shoals, which, were it not for the warning beacon, would strew the coast with wrecks.

Probably no other branch of our Government is of more importance to ourselves and to the world than the one under consideration, and no Department is better administered.

Commerce stays longest where it is most welcomed and best entertained. Where there are lighthouses there come ships; some may come where there are no lights, but with the welcome rays come the many and the richly laden.

Lighthouses, beacon lights, bell buoys, whistling buoys, fog bells, sirens and trumpets, are the guide posts which, by being properly described and located on the charts which are issued by the Government, enable the mariner, when near the coast, to keep in the safe road to his destination.

With the steady increase of commerce attending the civilization of the world, lighthouses and beacons have multiplied, until every civilized nation has its coasts more or less perfectly lighted, the lighting generally keeping pace with the increase of its commerce. As an incentive to commerce, and as a matter of humanity, improved methods of lighting should be adopted, without regard to expense, providing that the advantages gained are commensurate with the cost.

Lighthouses are of very ancient origin. The Pharos, at Alexandria, built by Ptolemy Philadelphus about 285, B. C., is the first light of undoubted record.

The finest lighthouse in the world is the Cordonan Tower, at the mouth of the river Gironde, in the Bay of Biscay. It was completed in 1611, and was 26 years in building. It is 197 feet high and rich in architectural ornamentation.

At the base is a circular building, 134 feet in diameter, in which are the light-keeper's apartments, and which also forms an outwork to break the force of the waves.

It has been modified and adapted to modern systems of lighting; and, after a lapse of more than 250 years, it is still considered the finest lighthouse in the world.

England and France each have towers built by their Roman conquerors, which were used as lighthouses.

Examples of modern lighthouses, which have been erected at great cost, and in spite of great natural obstacles, are the Eddystone lighthouse off the coast of England, near Plymouth; the Bell Rock lighthouse on the English coast, which cost $300,000; the lighthouse at Hehaux de Brehat, on the coast of France, and the Wolf Rock lighthouse at Land's End, England, the cost of which was $314,000. The great cost of these structures is owing to the difficulty of building the foundations, a few hours each day in most cases being all the time in which the work can be carried on, and which is stopped entirely in stormy weather.

The Wolf Rock lighthouse mentioned above is the latest British work, and both in its structure and its illumination combines all the modern improvements. Commenced in 1862, it was not completed until 1869, and yet the time occupied in building was only 101 work days of 10 hours each.

The whole number of light stations in the world is about 6,000, of which some 250 are shown from light ships. Of these light stations, Europe has 3,309, North America 1,329, Asia 476, and the rest of the world about 811.

The United States has within her boundaries an eighth part of all the lights in the world.

The cost of maintaining these lights, including beacons, buoys, etc., is sustained by the United States Government, the Secretary of the Treasury being *ex officio* President of the Lighthouse Board, the other members being officers of the navy and of the Engineer Corps of the army. The idea of the Government is that light should be as free as air, that the lights and aids to navigation are not only for the interests of commerce but for the sake of science and humanity, as are the sister institutions of the Coast Survey and the Life-Saving service.

Great Britain, notwithstanding her boasted free trade, imposes a tax called light dues on the commerce of the world. These dues differ with the importance of the lights passed, the size of the passing vessel, and the nature of the cargo. Payment of these dues is made to and enforced by the Custom House officers. The light dues paid by American vessels in the year 1856 amounted to $160,000. In the same year the U. S. Government maintained on its 64,000 miles of coast line (including bays, inlets, etc.) 700 lighthouses, 238 fog signals, 388 day beacons, and some 4,300 buoys, besides 250 lights on the great lakes.

Great Britain stands almost alone among the great nations of the world in the imposition of this tax on commerce for coast lighting.

Austria, Mexico and most of the South American States also collect light dues; but the general tendency, particularly on the part of Great Britain, is towards a reduction, and ultimately the total abolition of this tax.

The great extent of territory and coast line under the administration of the U. S. Lighthouse Board cannot be set forth here, but stated briefly. There are 16 lighthouse districts, each in charge of proper officers. The appropriations for this Department have increased from $22,591.94, in 1791, to $3,238,925.83, in 1890.

The theory of the Government in the matter of coast lighting is that each coast shall be so set with towers that the rays from their lights shall meet and pass each other, so that a vessel on the coast shall never be out of sight of a light. Hence, from year to year, the length of the dark spaces on its coasts is lessened or expunged entirely, and the day will come when all its coasts will be defined from end to end by a band of light by night, and be well marked by beacons by day.

The first lighthouse on this continent was built at the entrance to Boston harbor, on Little Brewster Island, in 1715–16, at a cost of £2,285 17s. 8½d., a large sum in those days. It was supported by light dues of 1d. per ton on all incoming and outgoing vessels except coasters.

The principal rivers of our country are lighted by portable lanterns, hung on posts of uniform color and construction, so that they serve as landmarks by day. They are attended by the people living along the banks. There are 1,557 of these river lights, and the number of miles lighted is 4,477.

The illuminating apparatus or material used by the Lighthouse Establishment varies with the dates of its use, and has kept pace with the improvements in artificial lighting for other purposes than navigation.

The earliest lights were simply fires kindled on the ground or suspended in iron baskets, the fuel being pitch and oakum. Such an one was illumined on Point Allerton, Mass., in 1673.

The lighthouse on Little Brewster Island, Boston harbor, erected in 1715–16, was first lighted by tallow candles, then followed the spider lamp burned in the lantern as it might have been in a window.

In 1812 the Government purchased a patent called a magnifying and reflecting lantern. This is described as consisting of a lamp, a reflector and a magnifier. The reflector, of silver-plated copper, had much the grain and luster of tinware, and would reflect no distinct image. The lamp, roughly constructed on the principle of Argand's fountain lamp, burning from 30 to 40 gallons of oil per year, had a ¾-inch burner, and was attached to a circular iron frame in front of the reflector.

Before the lamp was the so-called lens, of bottle green glass, from 2½ to 4 inches thick through the axis, and 9 inches in diameter. The effect of the whole was characterized by one of the inspectors as making a bad light worse. Eventually the reflectors were made on true optical principles, approximating, if not reaching, the paraboloid form, were heavily silvered, and were properly placed.

But a poor light was the rule, and a good light the exception, and the Lighthouse Board, in 1852, finally adopted the Fresnal lenticular system, which had been found successful in France and other countries.

The lenticular apparatus consists of a central powerful lamp, emitting luminous beams in every direction, around which is placed an arrangement of glass, so formed as to refract these beams into parallel rays in the required directions.

A first order lenticular apparatus is a most beautiful object. It stands nearly 12 feet high, and is 6 feet in diameter, and involves in its structure some of the highest principles of applied science. The cost of the lenses alone varies from $4,250 to $8,400.

The distance from which the principal lights can be seen is only limited by the horizon. They might be seen 60, 80, or even 100 miles, if sufficient elevation could be gained from which to view them. It is deemed

that 250 feet is the maximum height necessary or advisable to give a light. This gives a horizon 18 miles distant.

As before stated, the illuminants used have been changed as the science of artificial illumination has been improved, and the scientists employed by the Board are always experimenting with a view to new discoveries in this direction.

The fires of pitch and oakum, used in the open brazier at Point Allerton, Mass., in 1673, were succeeded by tallow candles, at Little Brewster Island, in 1716, which gave way to fish oil burned in spider lamps, with solid wicks, suspended by iron chains from the dome of Sandy Hook lighthouse, as late as 1760; and this was in turn succeeded, in 1812, by sperm oil burned in a sort of Argand lamp, in Winslow's patent magnifying and reflecting lanterns, previously described.

The use of this illuminant was continued until the beginning of the latter half of the present century.

When, by reason of the yearly diminution of the whale catch, and the increased use of sperm oil as a lubricant, this material became more and more expensive, experiments were made with whale, shark, fish, seal, colza, olive, lard, and mineral oils.

Analyses of these substances, quantitative and qualitative, chemical, photometric, etc., were made by Professors Muffit and Alexander, of the University of Maryland, and published by the Board, in 1855.

It was found from these examinations that colza, a vegetable oil, was largely used in France, and would comply with all the required conditions, except that it was not a home production.

This oil could be bought for $1.00 per gallon, when sperm oil sold for $1.64½ per gallon.

As a result of further experiments, lard oil was used, and this became, after 1861, the established illuminant. The highest price paid for sperm oil was $2.43½ per gallon; the lowest $1.09. The highest price paid for lard oil was $2.27; the lowest, 48½ cts. per gallon.

As early as 1807 the Lighthouse Establishment entered into a correspondence with the owners of the good ship *Corlomande*, from Rangoon, in the kingdom of Ava, relative to 5,000 gallons of earth-oil, which is commended as the "best article known for burning in lighthouses, making a very strong, clear, and bright flame, emitting at the same time a great volume of smoak." It may be that then, as often since, the "great volume of smoak" prevented the use of the earth-oil. In 1855 the price of lard oil having much increased, experiments, unsuccessful at the time, were made with the various forms of petroleum.

The matter was approached with much caution as the volatile, inflamable, explosive nature of mineral oil was well known.

The keeper of one of the lights on Lake Michigan had, in 1864, on his own notion, substituted for the usual lard-oil lamp one burning kerosene. Soon after commencing its use he attempted to extinguish it by blowing down its chimney, when it exploded. He had scarcely reached the foot of the staircase, when another explosion took place, which blew the whole lantern from the tower and effectually destroyed the lenticular apparatus.

But as mineral oil was, in one form or another, in successful use in European lighthouses, the Board set about solving the problems connected with its uniform and economical combustion, its purchase in the large quantities needed, its tests as to purity, and the degrees of heat at which it should burn and flash, the degrees of cold at which it should remain liquid, methods for its transportation and storage, and the other questions connected with its safe and economical use.

During a long litigation, as to the infringment of a patent by the use of a certain lamp, the Board, after much experimentation in its own laboratory and workshops, succeeded in producing a mineral-oil lamp capable of consuming all the carbon it set free, and introduced it into its lighthouses.

The flashing test was fixed by the Board at 140° F., the fire test at 154° F., and the freezing test, at which it would remain limpid, at zero.

Litmus paper immersed in it for 5 hours must, by remaining unchanged in color, show its freedom from acid; its specific gravity must not be less than 802°, and it is to be paid for by weight at the rate of 6⅝ lbs. net weight per gallon.

Mineral oil is now used throughout the Lighthouse Establishment, and for safety it is kept in 5 gallon cans. At present prices, it may be roughly stated that mineral oil, as compared with lard oil, gives one-fifth more light and costs only one-seventh as much money.

The propriety of using gas as a lighthouse illuminant has several times been considered. In 1844 an effort was made to use rosin gas at the Christiana light station, near Wilmington, Del., but, after something less than a year, it was abandoned as impracticable. Another unsuccessful attempt was afterward made at the light station, on Reedy Island, mouth of Delaware river.

From time to time lighthouses near cities have been illumined with gas from the city gas works. It is now used in but three stations, namely, Cleveland, O., Alexandria, Va., and Newburyport, Mass. At these places a set of oil lamps is kept ready for use in case of failure from any cause of the gas supply.

While the Board has not found the use of gas practicable thus far, it keeps itself informed as to the progress made in its manufacture and combustion.

Compressed gas is used in lighting the 10 lights at the northern entrance to the Currituck Sound, N. C. This gas is made and compressed at its own gas works, and it is carried to each of the beacons in tanks built into a scow, which is towed by a steam launch. The gas will burn in each beacon for 10 days and nights if required.

The iron structure, located on the Dry Romer Shoal, in New York Harbor, is lighted by compressed gas. This light, which is a very important one, was first lighted on the night of July 15, 1886. The iron tank containing the compressed gas holds a 90 days' supply. The compressed gas apparatus, which is of the Pintsch system, cost $3,750. The cost of the whole station was $14,336.60, much less than the cost of a lighthouse, and its cost for maintenance has been much less, as no keeper is needed. It has worked fairly well, but it has not been duplicated.

A combination gas machine is used to furnish the light to some of the stations on the northwestern lakes; among others, that at the Maumee Range lights, Lake Erie, O.; at the Marquette Breakwater pierhead, Lake Superior, Mich.; and at the St. Louis River pierhead, Lake Superior, Minn. This machine works automatically, making the gas from gasoline, and furnishing a light which can burn, according to the size of the machine, from 30 to 90 days without attention.

It is used at stations which may be inaccessible for days during stormy weather, without great danger to the keepers, who live on shore. It is inexpensive in proportion to its utility, and thus far it has worked so well that it will probably come into more general use.

The Lighthouse Board has watched the experiments made in other countries with the electric light as a lighthouse illuminant, and while it does not consider that this light can be seen farther than its own best lights, which are seen, located and identified as far as the curvature of the earth will allow, and while it is not yet convinced that the electric light can be located or identified better, or even seen in fog farther than its oil lights, still, for purposes of practical experimentation, it has—unsuccessfully, however—for several successive years asked Congress for such an appropriation as would enable it to erect and put in operation an electric light by the side and in competition with an oil light. Meantime it has tested every prominent American built machine for making the electric light, that it might be ready to use the best when Congress had provided the funds for that purpose. The results of its experiments are published in the annual reports for 1879 and 1880.

The electric light tower, at Hell Gate, Astoria, N.Y., was 255 feet high and 54 feet square at the bottom. It was built in 1883–4. It cost about $11,000 to build, counting everything. It showed 9 electric lights, each of 6,000-candle power. It accomplished all that was intended and more, for the light was so brilliant that it dazzled the eyes of the pilots, and prevented them from seeing objects beyond the circle illuminated. The shadows thrown were so heavy that they took the form of obstacles. The light was discontinued in 1886, at the instance of those who had obtained its establishment.

The celebrated Statue of Liberty, in New York Bay, is lighted by electricity. There are 9 duplex electric lights in the torch held in the hand of the statue above its head, at a height of 305 feet above the sea level, and is visible 24½ miles at sea.

There are also 5 single arc lamps on the salient angles of the fort enclosing the statue, designed to light the statue itself. In this respect they are a total failure, as they hardly light the stone structure supporting the statue, and their expense might well be saved by their removal.

The main entrance to the harbor of New York is lighted, in addition to its well-known lighthouses, by a system of buoys lighted by incandescent electric lamps, operated through submarine conductors, connecting with a generating apparatus on shore.

The channels, which are the only entrances possible for deep draught vessels, are lighted by these buoys, allowing these vessels to enter and depart by night as well as by day. These lamps are rated at 100-candle power each, and are protected by light but strong wrought iron cages firmly secured to the wooden buoys.

The lamps are operated from the electric light station on Sandy Hook. A stationary beacon off Sandy Hook, formerly lighted by oil, is also lighted by electricity from the same station. These lights have been in successful operation since November, 1888. During the year 1889 these lamps were extinguished by reason of accidents from various causes,

such as storms, short circuits, breaks in cables, broken lamps, etc., for about 535 hours.

The British Government, by a Commission created in 1885, carried on a series of experiments relating to the comparative merits of gas, electricity, and mineral oil as lighthouse illuminants. The experiments covered a wide range of conditions, such as fine, clear weather, haze-fog and dense fog; and the conclusions arrived at established the fact that a dense fog rendered *all* the lights useless to navigation, and that the advantage of the most powerful illuminant (electric light) was reduced to a nominal and unsatisfactory element equally with the gas and oil illuminants—the electric light being visible but a few hundred feet farther than either of the other lights under such conditions.

It appears that the penetrative power of light through fog differs according to the varying conditions of its homogeneity, or, in other words, the greater or less size of the particles of aqueous vapor in suspension. Sound signals are affected in a similar manner.

The Commission indicated that the electric light stands first in the rank of lighthouse illuminants in clear weather. It claims that for first-class points of coast lighting nothing can be more desirable, if expense be no matter of consideration. The most economical, safest, and easiest for storage, equally available for rock, floating, or coastwise stations, was decided to be mineral oil. The lamp in which this material is used has been so perfected by British and American engineers as to be comparatively equal to the electric and gas lights, in its capability of increase of power, to adapt it to the varying atmospheric conditions.

Gas light is used in several stations on the coast of Ireland. Cannel coal gas, manufactured and stored on the spot, is conveyed to the burners, which are capable of increase of power varying from 28 to 108 jets, according to the power necessary for the station or for the state of the atmosphere. This system is open to objection, although its efficiency is allowed to be of considerable value.

In regard to the use of gas, the Commission in summing up say: "When shown through fixed lenses the superiority of the superposed gas light is unquestionable. The larger diameter of the gas flames, and the lights being much nearer to each other in the gas lantern, give the beam a more compact and intense appearance than that issuing from the more widely separated oil burners."

It will be seen by a perusal of the foregoing part of this article that gas as a lighthouse illuminant has been but little used, and is not recommended for the purpose by those in charge of this department.

For lighthouses located on small rocks, or in especially exposed positions, the use of gas could not be expected; but a great number of first-class lights are so situated that gas manufactured and stored on the premises, or transported in a compressed state at regular times, could be used with success.

The increased uses of gas for light, heat, and power make its use for lighthouse purposes more possible and practical than ever before. It may be that in the extensive experiments in the use of electricity the subject of the use of gas has been somewhat overlooked. The manufacture of gas has not only been wonderfully improved, but its use in new fields has been much extended under the stimulating effects of competition since the advent of the electric light.

As an example of the use of gas, take a lighthouse having a fog signal driven by machinery connected with it. The light for the lantern and for domestic purposes, the cooking for the keeper and his family, and the gas engine for the fog signal machine, could all depend on a small gas plant easily attended to by the keeper, who usually must have an over-abundance of time. The storage of oil or coal for the gas supply would in most cases not be a matter of great expense.

When we consider that the total commerce of the world amounts to 21,048,704 tons,* it will be seen that this department of the Government is worthy of more than the brief notice given in this article.

Modern Conceptions of Electricity.

By Dr. Louis Duncan.

[A paper read before the Franklin Institute, and reprinted from the revised report of the same in the *Journal* of the Institute.]

I will try to tell you to-night what I think some other people believe with respect to electricity, or at least I will give so much of their belief as I hold to be sound. But we must begin at some little distance from the main title of my paper, for we will find, I think, that to understand the nature of electrical action we must first understand the general type of the various actions which go on around us.

For the industrial life of mankind is made up of two things, the transformation of material and the transformation of energy. All of our endeavor, all of our labor is only to make more useful to us the things we have already on the earth. The supply of material in the world is practically constant; nothing drops off of it as we whirl through space, and the only thing added is some stray meteorite, insignificant except in the way of a sign or wonder. And it has been known for a great many years that mankind cannot destroy or create matter. So we must be content to take what has been given us, and with a little earnest jugglery to change a mountain into a steamboat, to change dirt into a plate-glass mirror, and to make sugar out of coal tar.

But with respect to energy the case is somewhat different. The earth is constantly receiving energy, constantly losing it, and the amounts very nearly balance. It would be very unfortunate, indeed, if we were for one day to fail to receive our accustomed supply of energy from the sun, and it would be extremely uncomfortable if all the energy received for 24 hours were to be bottled up on the earth and not allowed to escape. For the sun supplies the energy that makes life possible here. Although the supply is not constant, yet as far as we are concerned, or any agency we are acquainted with is concerned, the same law of limitation holds as holds for matter—we cannot create energy—we cannot destroy it. But we spend a great deal of time in transforming it. By the stored energy in the coal we drive our engines; all artificial light is energy transformed from coal, or oil or wood to the energy of luminous radiations. And all of the energy we utilize we can trace directly or indirectly to the sun. It is the heat of the sun which causes the chemical changes which make up the growth of plants, and this energy remains in the plant after it has become fossilized and appears again as heat when we burn the coal. The energy of our rivers and streams comes from the sun, too—for its heat vaporizes the water of the ocean and makes the winds which carry it over the land where it falls as rain, and flowing to the ocean again, runs our mills and factories. The sun is the universal source of energy, and so of life on the earth, and this energy comes to us as radiations, heat and light, as we call them when they have suffered other transformation, and as I shall hope to partly prove that these radiations are really electrical, then we see that we have been unconsciously very dependent on electricity, although it is the fashion to speak of it as a matter still in its infancy.

The solar system is losing its energy. There exists to-day not one two-hundredths of the amount which existed when the system was created, and it is a curious question as to where the rest has gone. Perhaps it has helped to make up new systems and worlds, perhaps, beyond the confines of what we call space, the law of conservation no longer holds and the energy is annihilated.

The electrician is mainly concerned with the transformations of energy, and material only affects him as it modifies these transformations. The principal virtue of electrical applications lies in the ease with which they allow transformations otherwise difficult to be made. For example, I have here some pieces of apparatus which will illustrate this. Motor, Geissler tubes, piece of carbon, induction coil and jars. What we want to understand is how this transmission takes place.

For the last half century the great advances in physical science have been through the application of the law of the conservation of energy. Energy disappears at one place and appears in another form, perhaps in another place. The two quantities are equal, or if they are not equal the difference must be accounted for by some loss which must be discovered. The law leads readily to equations, and these have given results of great importance. But in the last few years the attempt has been made to trace the path of the energy, which, leaving one place, appears at another. We try to label a given portion of energy—the energy in a given piece of coal, say—and to follow it into the boiler, and then to the engine, and then, perhaps to a dynamo, and, finally, as electric energy, to this electric lamp. It has suffered a number of changes, it has passed through many forms, but, finally, that individual portion of energy has reached the lamp, and being changed into radiations, has started on a journey causing a shudder of the ether through the universe and reaching the confines of space.

It is by tracing these various actions that we have arrived at our present notions, and we have traced them backward, beginning with the energy after it has become radiant.

Ever since the undulatory theory of light began to be held it became evident that there must be some substance pervading all space which would transmit the vibrations which constitute light. It is evident that if light is vibratory, something must vibrate and as there is no matter in the space between the earth and the other heavenly bodies, there must be something besides matter filling the space. This hypothetical substance was named the ether, and every later discovery has added evidence as to its existence, until now we may consider the ether as a

*Vessels under 100 tons and yachts excluded; also the lake and river tonnage of the United States.

proven fact. And in late years the notion of the ether has assumed greater and greater importance. Sir Wm. Thomson has advanced the theory that matter itself is but ether under various conditions of motion, and he, together with J. J. Thomson, has in some way proved it. If we can account for matter by modifications of the ether, then ether and energy, with the phenomena incident to them, may give us an entire mechanical explanation of the universe, and we can believe that, as far as this mechanical explanation is concerned, we need but ether and motion. And the importance of the ether to us to-night is this, that it seems more than probable that all electrical actions of whatever kind and however made apparent, are transmitted through the ether and by it; and, indeed, the term electricity itself may very well be a misnomer, and electricity positive and negative may only be two phases of the ether.

This etheric theory is an attractive one. To unify all the phenomena of nature, and to refer them to the same cause has been the dream of philosophers for many years. But although the conception is simple enough, the details are to us very complex, partly, perhaps, because we are ourselves entangled in that very complicated modification of ether called matter, and cannot perceive things which in their essence are only too simple for us to grasp.

In order to appreciate the change which has taken place in electrical ideas, let us briefly examine the old notions of what constituted the charge of a condenser, and of how electrical energy was conveyed by a wire. In the first case it was held that when we charged a Leyden jar there was a certain definite amount of the fluid electricity upon it, positive electricity on one coating, negative upon the other. When the jar is discharged the two fluids rush together and neutralize one another with some little noise and heat. The thoughts of the experimenters were concentrated upon the charged bodies. If there were two of them they attracted or repelled one another, this was the important fact. It remained for Faraday to show that the space around a charged body had an important part to play in the phenomenon. Substituting sulphur for air between the coatings of a condenser he proved that the capacity was greatly changed. From that time more and more attention has been paid to the space around charged bodies and less to the bodies themselves, until we have begun to consider the latter as simply serving to make evident to us something which is taking place in the surrounding space. But we will talk further of this in the light of some experiments which I will try later.

Our views about an electric current have also been profoundly changed, but much more lately; indeed, the new ideas have not spread very widely even yet. The old idea was that the fluid electricity flowed through a wire very much as water flows through a pipe. But the new idea is that the energy does not flow through the wire at all. At every point along the wire enough energy passes into it to account for the amount of heating done, but the energy is transmitted by the ether outside the wire. If I am running this motor then the energy used in running it does not pass through the wire at all, but passes from the dynamo at the electric lighting station to the motor through the ether. The wire acts as the core of a disturbance in the ether making the transfer of energy possible, but not itself transferring it.

But it is in another field of electric transfer that we have learned most about the real actions which go on, and a great part of our knowledge is due to three men—Faraday, Maxwell and Hertz. Faraday was the son of a blacksmith. In his youth, apprenticed to a printer, he read the proof of scientific books passing through the press, and finally so impressed Sir H. Davy that he gave him a position as an assistant at the Royal Institution, where he succeeded his benefactor as Professor of Natural Philosophy, and where he carried on those researches which made him famous. In his endeavors to unify the different phenomena of nature, he was led to look for some connection between magnetism and light, and he found that there was such a connection, the plane polarization of light being rotated in a magnetic field.

Maxwell, drawing his inspiration from Faraday, investigated the propagation of an electrical wave through space, and found that it followed the same laws as do light waves, and the velocity was the same as that of an electrical constant, which, on determination, proved to be that of light. So he advanced the hypothesis that light is really an electrical phenomenon. The proof of the hypothesis, however, rested on the fact that velocity of the electric disturbance was that of light, and that certain other electric constants bore the relation to optical constants that theory indicated. It remained for Hertz, a young German, scarcely 30 years old, to show by direct experiment that electrical waves are practically identical with those of light, and to put the electro-magnetic theory on a firm foundation. His method was to produce electrical waves of very short period, say $\frac{1}{100000000}$ of a second, and to directly investigate the method of their propagation. I have indicated on a large scale one way of experiment.

In the first place if we have two tuning-forks of the same pitch and sound one of them, the other will sound sympathetically as it is called. Air waves are formed by the first fork, and these impinge on the second causing motions, slight at first, but which are successively added, provided the forks are in tune, until the second fork sounds audibly. If the two are not in tune, the successive impulses are not added, but neutralize one another.

Now, is it possible to try a corresponding electrical experiment, and do the same thing with electrical waves that we have done with air waves? In the first place, when I discharge this Leyden jar, the only thing we see is a flash of light. But if the energy of this charged jar is really stored up in the ether, then the ether is in a state of strain just as a stiff steel spring would be if it were fastened at one end and the other pulled aside. When we let go the spring, it will vibrate for a while, and in the same way when we let go the electrical strain by discharging the jar there will be an electrical vibration, and as the rate of vibration of the spring depends on its stiffness and weight, so the rate of electrical vibration of the jar depends on its capacity and the self-induction of the discharge circuit. That is, if the jar is smaller the time of vibration is less, and it is smaller for a short than for a great length of wire. So by having a very small capacity and short wire, Hertz has obtained 2 x 10⁸ vibrations in a second; a number comparable with the vibrations of light.

Suppose we have a circuit of wire with a break in it, and suppose I set up vibrations in the circuit; then I have another circuit which also has a break in it, and I can increase the capacity and therefore change the time constant of either circuit by putting these jars in the circuits. Now, if waves are really sent off from the first circuit, and if the two are in tune, then I may get indications in the second. If I put the two circuits out of tune, there will be no indication in the second. You see the results. This experiment shows us that waves of electric energy are transmitted through the space between the circuits, and it is very imperfectly Hertz's method of experiment. With circuits so small that they could be easily carried about, he investigated the direction of the waves and their length. He found that they were reflected like light waves; that they were refractive and, in fact, that they were practically identical. He directly measured the velocity, too, and found it to be, as nearly as he could measure, the same as that of light. In fact, the evidence is all but conclusive that light is an electro magnectic phenomenon, and we know that light is transmitted by the ether, so we have at least one form of electric energy, which is transmitted by the ether.

Now let us take up another form of transmission; namely, along a wire. Here we must try to label the energy coming from the dynamo and follow it up to this lamp or motor. Poynting and Heavyside first proved mathematically that the energy appearing in the wire in the form of heat rains down on the wire from the space around it and the matter has an important practical bearing. Suppose I have a tube, open at both ends, immersed in a tank of water and suppose the length of the tube is great compared with its diameter. I can represent with it the old and the new idea of electric currents. If there is a piston in the tube and if I push the piston through, the water which represents the current will move steadily along the tube; the velocity of each point in its section is the same, it will move as fast near the outside as in the middle. If we move the piston back and forth rapidly, we will have a current alternating in direction, but the distribution of velocity will still be uniform. Now, suppose we remove the piston and simply move the tube in the water. If we move it slowly and in one direction, the friction of the sides will carry the water along with it, the current being represented by the rate at which the water passes a fixed point and the distribution is uniform. But if we move the tube rapidly back and forth through a short distance, the condition of the water in the tube will be different according as it is near the center or near the outside of the tube. If the alterations are rapid and the the amplitude is small, then the water near the center may not move at all. In the first case, we have a current caused by a force acting along the wire; in the second, by a force all along the wire on the outside. The effect is the same for both in the case of a steady motion, corresponding to a steady current and the distribution is uniform across the section, as it is in the case of a steady current through a wire. But in the case of the alternating forces the results are different; a force along the axis giving a uniform distribution, the force acting from along the outside giving a greater motion near the surface. Which of these corresponds with our experience in the case of alternating electric currents? The last does. With an alternating current along a wire if the period be very small a very little of the current reaches the center.

Other experiments show the same thing almost conclusively—namely,

that the energy of an electric current is conveyed by the ether around the wire. But if the wire does not convey the current, how does its presence affect the ether in its neighborhood? With our present knowledge of the properties of the ether it is impossible to say. We may represent the state of things, if we wish, as Lodge has done. He imagines that the ether is made up of a number of cogwheels meshing into one another, and he further imagines that a conductor consists of wheels which have no teeth, but whose rims can slip over the cogs with a certain amount of friction, and so with a certain production of heat. If we had nothing but the cogs we could not make them rotate, for they would tend to turn each other in opposite directions and would stick fast. But with a number of wheels over which the cogged teeth could slide, rotation would be possible and we would have a condition of affairs representing a current.

If the wheels were elastic, then, if we try to turn one of them, there being no conductors around, the wheel would turn slightly, and this partial turning would be transmitted to the next, and so on; there being a definite strain through the whole space due to the stretching of these rubber wheels. And Lodge would represent the charging of a Leyden jar by this—the distention of the wheels representing the strain in the ether. We must then consider the charge of a Leyden jar as represented by a partial rotation transmitted through space with a velocity dependent on the elasticity of the wheels and their mass. When we discharge the jar, the wheels are relieved from their strain and oscillate for a while about their position of rest. If we will consider for a moment, we will see that if there were such wheels half would revolve with, half against, the hands of a watch; and this difference in the direction of rotation of the wheels may be taken as in some way representing the difference between positive and negative electricity.

And this model of the ether would in some way explain magnetism. The rotating cogged wheels represent magnetic effects, and if they rotate they must of necessity be included in a current. So we only have to adopt the old theory of Ampere, who supposed magnets were made up of a great number of small currents circulating around the molecules of the magnet, and our model fits in with the facts of magnetism also. But no one—least of all Prof. Lodge—believes that this actually represents the mechanism of the ether. It helps us to have some definite notions, and no one has been more helpful than Prof. Lodge. But whatever the exact nature of the actions, there is not any doubt that some motion of rotation in the ether accompanies electrical and magnetic actions, and that electrostatic actions are caused by a strain in the ether.

We have taken up in an imperfect way three types of electric action, or rather four. Electrical waves, electrical strains or static electricity, and electric currents, and in the latter we have included magnetic actions, especially if we accept Ampere's hypothesis. There is one thing we have not taken up, and that is the passage of an electric current through liquids. But this I will not take up.

So much for the transmission of electric energy; for its sources we can go in many directions. The largest, most important, and cheapest source of electrical energy is the sun. The energy which makes up the organic life on the earth, the energy which causes the growth of every flower and plant and animal, comes to us as electrical energy. Through many transformations, after long waiting sometimes, the electrician takes it again, transforms it a second time into electrical energy, and then distributes it for the uses of mankind.

Gas Mains and Joints.

A writer in the London *Journal* says it would be a useful effort on the part of a young gas engineer desirous of preparing a paper for a technical society to review critically the various known methods of main pipe jointing and laying, having regard to the multiplicity of conditions governing the laying of gas mains. A good deal has at various times been published on this subject; but in many cases main laying papers have been written with the object of recommending some particular device; and the critical faculty has not been conspicuously exercised in this regard, except in very few instances. Yet by this time a mass of practical data has accumulated concerning main laying work in town and country, at home and abroad; main laying in rocky ground, in made ground, in wet ground; main laying across rivers and arms of the sea; main laying on bridges, in subways, and through sewers; permanent trunk main laying; light temporary main laying; and half a score of other branches of the art and mystery. Nobody has attempted to reduce these data to order, and consequently a good deal of experience stands in danger of being lost to the world. Attention has been drawn to this subject of late by the deliberations of the Select Committee of the House of Commons upon the main laying and steam roller clauses of the Metropolis Management Act Amendment Bill, the object of which was to prescribe for London a minimum depth for gas mains and a maximum weight for road rollers, at which these respective servants of the public might be legally regarded as mutually innocuous. The clause was rejected (as already recorded in the *Journal*) on account of the practical impossibility of settling the conditions of mutual security for mains and rollers; but if it had passed, it might have been cited as the first direct statutory recognition of the usual system of main laying followed by British gas undertakings. At present, of course, the law is indifferent to the way in which sellers of gas choose to deliver their commodity, with the sole reservation that their right to perform this service in a customary way will be recognized and upheld by the courts. For example, it has been argued in connection with the great steam roller lawsuit, that highway authorities have a right to make use of any improved means of repairing the surface of the thoroughfares over which they exercise jurisdiction, which may be indicated as necessary with reference to the convenience of the public. That is to say, that an authority responsible for the repairing of any road carrying heavy traffic are under a general responsibility for executing this work in the shortest possible time; and if they could do with a 20-ton roller in a day what would occupy two days with a 10-ton roller, their natural duty would be to use the former. To this argument it was answered that, in such a case, every gas and water main in the road would need to be a continuous steel riveted girder to bear such a load. The rejoinder was, "So be it." Whether gas was distributed through a cast iron jointed pipe or a riveted girder was nothing to the highway authorities, who had only their own business to attend to. It was the business of the gas undertakers to suit their system of distribution to the circumstances. But in the case that now governs the law as to such matters, it was held that the highway authorities had failed to establish the absolute necessity for using a steam roller of a weight to render cast iron gas mains of the usual pattern impracticable. Accordingly, the latter may be used when and wherever it is only a question between them and the fancy of a highway authority for a heavy road roller.

There are circumstances under which the cast iron gas main has to give way. In crossing a shallow bridge, or the crown of a sewer sunk but slightly under the road surface, the gas main naturally becomes a riveted girder. There is no question of the necessity in such cases. A peculiar experiment was made in London about 15 years ago, when a very shallow canal bridge was required to carry large gas and water mains. The bridge itself was constructed of a pair of horizontal box girders which also formed the parapets, and these were made to do a triple duty, as gas and water mains. In a matter of this kind, completeness of execution is everything; and unfortunately something went amiss with the connections of the gas main and the girder. There was an explosion; whereupon everybody exclaimed against the folly of the arrangement. If it had all gone right, the designers would have been as loudly applauded for their ingenuity. Everybody can see how silly it is to trust to a chain that happens to break.

In illustration of the observation that circumstances alter cases with gas mains as with other things, the incident that recently occurred in New York, and was recorded in the *Journal* a fortnight ago, may be cited. The complication of conduits, pipes and wires under the surface of Broadway, New York, has often been noted in local technical journals, which have never ceased to prophesy evil as the consequence of the blameworthy laxity of the city authorities in permitting the use of the subsoil to any company who know the right kind of arguments to employ in asking for permission to lay mains, etc., underground. In this case, the New York Steam Heating Company opened the street in order to get at their main, which ran under the gas mains. The trench was timbered, and somehow a leak started in an exposed joint of a gas main, which ignited at a lantern dropped by a workman. The gas flame increased as the lead was melted out of the joint, setting fire to the timbering of the trench. Owing to the competitive system of gas supply favored in the States, and peculiarly exemplified in New York, at least 12 gas mains crossed this blazing trench, and every one, as fast as the lead ran out of the joints, contributed to the impromptu volcano that was formed in the middle of the road. The scene was a striking one, although probably the gas companies who contributed to the effect enjoyed the spectacle but poorly. It is reported that hardly any of the mains were provided with valves that could be used to shut off the supply without plunging whole districts in darkness; and so there was nothing for it but plugging the mains with bags. This work took 10 hours to complete, which does not say much for anybody concerned. When the gas was shut off, the flames were easily smothered; but not before all the electric light conduits and cables on one side of the street were destroyed.

A tale like this points its own moral. What the character of the districting work can have been like, that rendered it impossible to shut off a blazing main for 10 hours, we must leave to our professional readers to decide. It is another example of the slipshod engineering that too often passes muster in the United States, where the criterion appears to be not what is best, but what is good enough to serve the immediate purpose while everything goes right. As to the policy that allowed 12 gas mains to be exposed in one trench cut by the proprietors of something beneath, the blame for this must rest with the town authorities. If they have not ere now forgotten all about the incident, they must recognize that every superfluous gas main in a public thoroughfare is a public danger. One reflection may be permitted upon an occurrence of such gravity: How would it have been if the mains had been laid with turned and bored joints? The advocates of this description of joints have used many arguments in their favor; but we do not remember that they ever had occasion to anticipate such a proof as this New York case—that it may sometimes be advantageous to have a joint that cannot be melted out. This is, indeed, a novel consideration for application to gas mains other than those pipes in connection with carbonizing plant, which must be jointed with something that can stand heat. It offers an additional objection to india-rubber joints, which have never stood for long in gas mains. It also lends an additional advantage to asbestos packings.

There is plenty of material for the student of main laying in the devices that have been adopted for saving weight in carriage and labor in jointing for foreign jobs. Although the "Chameroy" piping, so largely used on the Continent, has never been introduced into the United Kingdom, where engineers lay mains as though they were intended to last forever, plenty of light piping is made here every year for distant gas works. It would take almost a volume to catalogue and describe the varieties of welded and riveted iron and steel gas mains, with their infinite methods of jointing, that have been made and laid in different parts of the world by English gas engineers during the last 15 years. It is not longer than that to the age when to the English engineers there was only one kind of gas main—cast iron; and only two kinds of joints—lead and turned and bored. Lead enters into a good many of the modern joints specially devised for the light mains now so commonly used for foreign works; being employed with flange joints, or in modified forms of spigot and socket joints, to overcome the difficulty of accurately fitting iron to iron. It is not with reference to the very remote possibility of a joint taking fire, as in the New York case, that we ask the question whether lead is really a satisfactory substance for making tight joints in iron or steel mains. We do not here refer to the old-fashioned lead and yarn socket joints, in which it is the yarn that does most of the work; but to the new-fashioned wrought-metal mains in which lead is employed to stop possible leaks through bad fitting. Sometimes the lead is used in the flange, and sometimes in fitting the flange or socket joint piece to the barrel of the pipe. Now, it is notorious that when iron is thus placed in connection with lead, and kept damp, galvanic action takes place at the expense of the iron. There is nobody to tighten up the bolts or caulk the joints in many such cases as the iron wastes away; and it is therefore only a question of time when the lead packing becomes loose enough to fall out.

The foregoing is only cited as an illustration of the criticism that might be usefully brought to bear on modern mains and their jointings. It is not possible to lay down a hard and-fast rule for practice that must be modified to suit a multiplicity of conditions. All that we contend for is that all sorts of pipes, with every variety of jointings, are being employed nowadays without coming under sufficient notice and discussion. Every engineer who lays a pipe line under any but the most humdrum conditions has a make of pipe and a pattern of joint of his own, which may or may not stand the test of time like the cast iron main and lead or turned and bored joints have done. Those who know most about the complexity of the conditions under which a line of gas mains may have to keep itself tight, however, are the most diffident of trying new methods. At the same time they are by no means disposed to think the old systems perfect, or to refuse attention to any plan that appears to have reason and knowledge behind it.

Hearne's Improvement in Purifying Boxes.

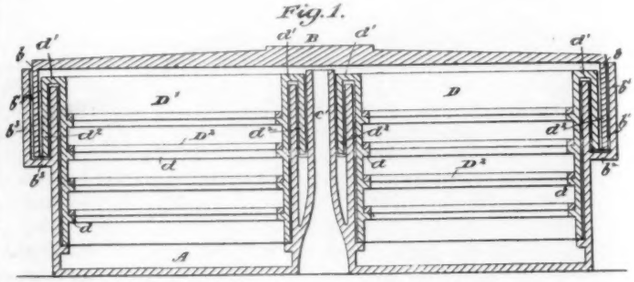
On July 29th U. S. Letters Patent (433,126) were granted to Mr. John Hearne, of New York, for "a new and useful improvement in gas purifiers." In his specification the inventor says:

In the drawings Fig. 1 is a vertical central section through two compartments of a box and the outlet pipe common there to. Fig. 2 is a top plan view of the same, the cover of the box being removed, and the tray holder being removed from one of the compartments.

A designates the body portion of the box, shown as of oblong form. It may be of any desired depth, and has an open top.

B designates the cover for the box. The edges *b* of this cover, when the cover is in position upon the body, rest in a water lute or seal, formed in a trough or gutter *b'*, extending about the box near the top of the latter, the trough *b'* has a closed bottom formed by a flange b^2, extending horizontally from and about the body *A*. One of its side walls is formed by the body *A* and the other by side pieces b^3, which ex-

Fig. 1.



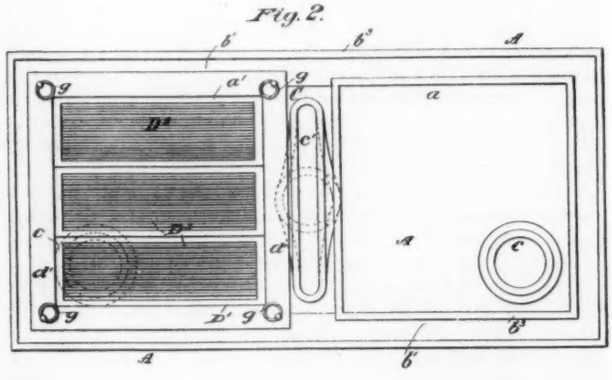
tend upwardly from the flange b^2 and somewhat above the top of the body *A*.

The construction thus far described is not new.

C designates a trough or gutter which divides the upper part of the body *A* into two approximately square portions or compartments *a a'*. The ends of this trough open into the trough *b'*. Water in the troughs *b' C* will therefore be in communication and at the same level in both. Gas enters at the ports *c* in the bottoms of the portions *a a'*, and, in the example of my improvement shown, finds exit through a pipe *c'*, extending upwardly from the bottom of the gasholder intermediate between the portions *a a'* to a point above the water level in the trough *C*. The outlet pipe *c'*, as it extends upwardly, gradually changes from a circular to an elongated form in cross-section, thereby economizing space between the portions *a a'* and affording ample space for receiving the gas which passes up through the trays.

D D' designate tray holders, in which trays or grids D^2, which may be of ordinary construction, are supported upon internal ribs or flanges *d*,

Fig. 2.



extending horizontally about the interior of the holders. Chemical material adapted to purify the gas is placed upon the trays or grids. The tray holders *D D'* are of approximately the same shape as the portions *a a'*, and extend with a loose fit into them, and, when in position, nearly to the bottom of the box *A*. They have open tops and bottoms. Near their tops the said tray holders are provided with horizontally extending flanges *d'* upon all sides. From the outer edges of the flanges *d'*, flanges d^2 extend downwardly upon all sides. When the holders are in position the sides of the portions *a a'* extend into the space formed between the flanges d^2 and the sides of the holders, and the flanges d^2 of the holders extend downwardly into the water lutes or seals formed in the troughs or gutters *b' C*. Between the flanges d^2 and the side pieces b^3 is sufficient space to receive the sides of the cover *B* when the latter is placed in position. Gas entering through the ports *c* will pass upwardly about and over the chemical material placed upon the trays in the holders *D D'*, and will, after being thus purified, pass outwardly through the pipe *c'*.

When the chemical material upon the trays or grids D^2 becomes exhausted and needs revivifying or renewing, or when from any other cause it is desired to remove the chemical material from the portions a a', I lift out the tray holders D D', and with them the trays D^2 and the chemical material. This is conveniently effected by means of any suitable tackle-engaging rings g with which the tray holders are provided. This may be effected very quickly and avoids all shoveling of the chemical material from the trays or compartments, as is now the common practice. The tray holders having been lifted out, other tray holders, which, in the intervals of charging, have been refilled with fresh material, may be as quickly lifted into position. The operation of the purifier may in this way be made practically continuous, being interrupted only for a sufficient time to lift out one set of tray holders and trays and insert a fresh set. The tray holders which have been lifted out may be conveyed away in any suitable manner and the material dumped from the trays where desired. The trays may then be refilled ready for a fresh charge.

Although I have shown and described two tray holders, I may, of course, use any desired number.

It will be seen that by my improvement very much time and labor are saved, the great danger of asphyxiation which laborers experience who enter purifiers as ordinarily constructed is wholly avoided, a simple and effective seal is provided which prevents the escape of gas around the tray holders, a free outlet afforded, and, because of the communication between the water lute which seals the tray holders and the water lute which seals the cover of the box, should any escape take place around the tray holders it could easily be detected from the outside.

What I claim as my invention is—

1. In a gas purifier, the combination, with the body portion of a box surrounded near its top with a water seal, of a cover adapted to extend into said water seal, and a removable tray holder supported in said box beneath the cover, and provided with a flange also extending into said water seal.

2. The combination with a box and purifying compartment within the box, of a water lute located between two purifying compartments, and a gas outlet pipe extending from the bottom of the gasholder up within the water lute, and having its upper end transversely elongated.

Shall Gas Undertakings Supply Electricty? Yes.

By Mr. Arthur F. Guy.

[An abstract of a paper contributed by the author to the British Gas Insiitute. Owing to lack of time the paper was not read at the meeting, but it will appear in due time in the next volume of the "Transactions" of the Institute.]

The general feeling prevalent among gas managers is that the electric light cannot affect gas, and in proof of this they point out the fact that since the electric light has been introduced the consumption of gas has increased. This statement is perfectly true, because artificial illumination is ever on the increase, whether it be by gas, candles, or electricity. Another argument put forward by them is that the electric light is in its infancy. Now this argument must be combated, because the term infancy is applied not only to usage but to the science of electrical engineering. The first point, namely, the "infancy of usage," is, perhaps, correct; but the second is not. We will consider the former first. There are some people who fondly dream that in this miraculous age of invention and discovery some means will come to light whereby any amount of electricity can be collected for next to nothing—in fact, a gift from Dame Nature, such as from some yet undiscovered chemical compound, or some peculiar condition of matter—and consequently that all our present costly and elaborate apparatus for generating electricity will become obsolete. No greater philosopher's stone was ever imagined.

With respect to the electric light being in its infancy as regards use, it is this fact that has shaped the title of the paper, for now is the time for the gas undertakings to act; it will soon be too late, and even now they have lost many a rich prize in the electric lighting line. Companies have been formed all over England to supply electricity, and the pick of the provisional orders have been relegated to either local authorities or private electric companies. This point joins issue with the supreme question, "Shall gas undertakings supply electricity? Yes;" and the reasons that justify this answer will now be given.

Consider the present state of affairs: there is a demand for the electric light; this demand is limited, but in time to come—and no one can say how soon that may be—this demand will be enormous. There are numerous reasons why it would be both politic and advantageous for gas undertakings to supply electricity.

The managing body of a gas works consists of men of great organizing and administrative experience. The gas works from long establishment have obtained a certain prestige and influence in the district they supply. A manager knows his customers, and has acquired an insight into the weak and strong points of his district. The connection and vested interests pertaining to the gas suppliers are often numerous and deep-rooted. A gas undertaking has also the great advantage of easily raising capital, at a comparatively low rate of interest; whereas new electric companies require financing, and the financing invariably leaves its mark upon them in the shape of a diminished dividend and an abnormally large capital. Many gas companies have large surplus moneys in hand which could be invested in running the electric light at a profit to their shareholders. In the laying of electric mains they know exactly the position of their gas pipes, and so there would be none of that friction and petty annoyance that often arise when the electric light company comes on the scene. With regard to the erection of plant, where possible the electric light station should be located in or about the gas works. In some cases, no doubt, there might be a spare corner or outbuilding which might be made to accommodate the requisite machinery. At all events, the expenses incurred need not be so great as where a new site has to be acquired and a new building is specially erected and positioned by an electric light company. A large staff of men are employed at some gas works, some of whom are mechanics, and the assistance which these could render, both in erecting plant and maintaining same, would be of no small value. In the case of an electric light company, such men would have to be specially engaged, and paid at fixed salaries, whether busy or slack. Besides this, most of the office routine might be done by the existing clerical staff of the gas company. This, again, in the case of an electric light company, would mean specially engaged and paid clerks. An electric light company would require a board of directors, general manager, secretary, etc., all of which means a heavy draw upon the dividends, and this matter alone is sufficiently important to turn what might prove a good dividend into a bad one, or even none at all. In the matter of running expenses, there are numerous ways and means whereby a gas manager has the power of curtailing them. For example, the hot coke from the retorts can be utilized in starting the boilers, and some of the bye-products might be used as fuel.

Through being a large consumer of coal for making gas, steam coal ought to be obtained at much cheaper rates. The same refers to the purchasing of other material. The manager knows the best market for certain goods, and through long connection therewith ought to obtain advantageous bargains. The opponents of this paper will probably contend that if a gas works offer all these advantages it proves that it is badly managed, since, if well managed, there should be the strictest economy in everything, and not a man employed except his time be occupied fully, and not a spare inch of ground in the works but that it has its use. This would be true if the management were perfect, but that point is never reached. No claim has been made that these advantages exist to a large extent, for that would certainly imply waste in the management; but that *some* advantage must be gained from each of these points under consideration cannot be denied.

It is the numerous small savings that in the total make up a respectable sum; however trifling each may appear by itself, when they are all added up at the end of a year it is just possible that they may come to a sum that will turn the balance to the right side of the ledger. It was stated that owners of gas property have great facility of raising capital. Now, with regard to this point, and also the opening up of streets for the purpose of laying electric mains, it is requisite that they obtain the necessary powers first from Parliament and the Board of Trade, and in furtherance of this they occupy exactly the same position as any private individual or other company (for the second object they must first obtain consent from the local authorities.) The same holds true where the owners of gas works are the local authorities.

Transportation of Crude Petroleum in the United States.

[Abstracted from a paper, read before the British Association for the Advancement of Science, by Mr. John H. Harris, of New York.]

The author explained that the only method of getting oil to market in the early days was by putting it into oaken barrels at the wells, each barrel of a capacity of 40 to 45 gallons. One or more of these barrels only could be drawn by teams (on account of the nature of the roads) from the wells in the wilderness to Oil Creek, where they were emptied into bulk barges, holding about 2,000 barrels. As Oil Creek was not navigable these barges were floated down the creek on what were termed "Pond Freshets." At different points in Oil Creek dams were erected, which set back the water, and ponds were formed. When a sufficiency

of water had accumulated a wing in the dam was opened, and these barges were floated on the flood to the next dam, and the operation repeated until they reached the mouth of Oil Creek at its junction with the Allegheny River, from which point there was good flat boat navigation to Pittsburg, the head waters of steamboat navigation in the Ohio and Mississippi valleys. This method of transportation was accompanied by great expense, incident to the loss of many of the boats with their contents in these drives, as well as the great labor and cost attending the building of the dams. The boats sold for what they would bring on their arrival at Pittsburgh. So late as 1862 the cost of sending one barrel of oil to New York was about $7.50, and the cost of transporting one barrel from Oil City at the mouth of Oil Creek to Pittsburg, about $2.30; the cost of transportation being so high as to break the market, oil at the time being sold at the wells at 50 cents per barrel.

In the latter part of 1862 a branch of the Atlantic and Great Western Railway was projected into the oil regions. Later, a line of railway was built up Oil Creek to Corry, a station on the Atlantic and Great Western, making continuous and direct railway connection to New York and the West. Still later, the Allegheny Valley Railway was opened up from Oil City, at the mouth of Oil Creek, to Pittsburgh, Pa., thus perfecting the railway system from the oil regions to the large cities. A number of narrow gauge railways were also built as feeders to the main lines. The lowest cost of moving oil by rail from the regions to the seaboard on the completion of these railways was about $1.04. Cylindrical tanks, 26 feet by 66 inches, made of light boiler plate, and mounted on eight-wheeled platform cars, and holding about 2,000 gallons, were used for its transportation. Bulk was broken several times, and the losses from leakage and evaporation were serious. In March, 1862, a bill was introduced in the Pennsylvania State Legislature at Harrisburg for a franchise to carry oil in pipes from Oil Creek to Kittanning, Pa., with the privilege of extending the line to Philadelphia. Nothing, however, came of this bill. Later on, in 1864, a scheme was outlined for laying a pipe line down the Allegheny River to Pittsburgh for the transportation of oil. A large proportion of the people in the oil country, teamsters, oil producers and railway corporations opposed this as a blow to their prosperity, and, like the former scheme, it came to nothing.

In 1865, the first pipe line was built from Pithole, Pa., toward Oil Creek, and oil was pumped through it, the distance being 3,200 feet. Three pumps were used, and 81 barrels of oil per day forced through from Pithole to Miller Farm, a station on Oil Creek. This pipe was maliciously cut from time to time by teamsters, whose monopoly promised to be destroyed by this new method of transportation, and it was kept from utter destruction by constant patrol of armed guards.

Later on in the same year a pipe line was laid from Pithole Creek to the Island Well, a distance of 7 miles. In November, 1865, still another pipe line was laid from Pithole to Titusville, which latter point was then the center of the oil producing districts, and also a great refining point. The cost of transportation so late as December 1, 1865, from Pithole to New York, was $5.75 per barrel.

Gradually the collection of oil was made by means of pipe lines running from the different wells to central stations, and thence to loading racks at the railway stations. Much opposition was encountered from teamsters, but finally overcome, and in 1876 there were no less than 8 or 9 different pipe line companies in the oil regions, whose lines radiated from the loading racks and storage tanks at the railway stations to the different wells in the interior. The business of these companies was collecting, storing and insuring oil at a stated price. They also issued storage certificates which were negotiable and used in commercial transactions as collateral. In 1875 a 4-inch pipe line was laid from the lower oil country to Pittsburgh, Pa., a distance of about 60 miles. This, the pioneer trunk line, as in the case of the early local lines, at first had to be guarded by armed men to protect it from disturbance from those whose interests it antagonized.

In the latter part of 1875, the great oil field of McKean county, Pa., known as the Bradford Oil Field, was opened up, and its production has steadily increased, until at the present time probably three-fourths of the oil production of America is in and near the Bradford field.

The total pipe deliveries from 1876 to 1884 were :

In 1876	9,068,376	barrels.
" 1877	13,012,713	"
" 1878	15,011,425	"
" 1879	20,085,716	"
" 1880	24,788,950	"
" 1881	29,674,458	"
" 1882	31,789,190	"
" 1883	24,385,666	"

Up to 1876 the refining of petroleum was carried on very largely in the oil country adjacent to the wells, and along the line of Oil Creek.

Meanwhile large refineries had been built at Cleveland, O., at Pittsburgh, Pa., at Buffalo, N. Y., and on the seaboard at Boston, New York, Philadelphia and Baltimore. The increase in the price of the products of petroleum, naphtha, paraffine and the residuum, for which there was no market obtainable in the oil regions, led to the greater development of refining at the lake ports and on the seaboard, where these products could be disposed of at a profit. This led to greater shipments of crude petroleum to these points, and as the business developed, the matter of transportation assumed such formidable proportions as to engage the attention of the refiners, who, under the lead of the Standard Oil Company, of Cleveland, O., associated with the principal local pipe lines, known as the United Pipe Company, and the American Transfer Company, surveyed and laid down pipe lines from the regions to Cleveland, Buffalo, New York, Philadelphia and Baltimore. They also purchased the pipe line, already in operation, to Pittsburgh, Pa.

The pipe lines of America, with but a single exception, are all amalgamated in one company, known as the National Transit Company. The length of the New York line is about 300 miles. There are two lap-welded wrought iron tubes, 6 inches in diameter the entire distance, while a portion of the way a third 6 inch pipe is laid. The number of pumping stations is 11, they are about 28 miles apart, and are equipped with duplicate compound condensing pressure pumping engines, and the greatest elevation between stations above tide-water is 2,490 feet. The Philadelphia line is 280 miles in length ; diameter of pipe, 6 inches ; number of stations, six. The Baltimore line covers 70 miles of direct pumping through a 5-inch pipe. The Cleveland line is 100 miles long ; diameter of pipe, 5 inches, with four pump stations. The Buffalo line, 70 miles long ; diameter of pipe, 4 inches, and has two stations. The length of the Pittsburg line is 60 miles ; diameter of pipe, 4 inches, with two pump stations. The entire length of these lines, including the duplicate pipes, is upward of 1,300 miles, while the length of the connecting lines of 2 inch diameter in the oil reigion is estimated to be from 8,000 to 10,000 miles.

In projecting these lines the experience of pumping oil through the short collecting lines of the oil country was of course available, but beyond that everything was simply conjecture. There were theoretical tables showing the resistance to be overcome in liquids passing through tubes for short distances, which, with a multiplier, would presumably give the friction for longer distances ; yet there were no tables based on practical results, and certainly it was entirely experimental to attempt to force oil through hundreds of miles of pipes, over a very broken country, crossing two ranges of mountains, with rivers and creeks innumerable. The engineering difficulties were novel, yet were uniformly and successfully met and overcome. Forcing oil through the smaller pipes and shorter distances of the oil country had been hitherto accomplished by means of single cylinder pumps, sometimes called donkey pumps. The limit of their usefulness had been found in the extension of the various local lines, by the bursting of the pipes, the stripping of threads at pipe joints, and the frequent breaking down of the pumps, incident to the constant shock and jar upon pumps, pipes and connections, at the change of stroke, under the heavy pressure due to enormous frictional resistance, as well as exceptional head, due to elevation.

Pumps were frequently put in on these local lines (most of which were 2 inches in diameter and 15 miles in length), where the frictional resistance was equivalent to a pressure of 1,500 to 2,000 pounds per square inch.

The steam cylinders on these pumps were in some cases of a diameter of 30 inches, moving a ram of only 4 or 5 inches, and the concussion at each change of stroke under these pressures resembled the report of a rifled gun. Of course these conditions were preposterous, and in fact prohibitory, no pipes or material being found equal to the excessive and intermittent strain.

After mature consideration, a committee was appointed to wait upon the late Mr. Henry R. Worthington, of New York City, who in his lifetime was undoubtedly at the head of hydraulic engineers in America, and asked him to consider the conditions of the service and give his opinion as to the type of pumping engine best adapted to meet these severe conditions. The result was that an engine was designed and constructed by Mr. Worthington, sent to the oil country located near Bradford, set up, and connected to a section of pipe line of 4 inches diameter, 16 miles in length, reaching from Bradford to Carrollton, an oil station on the Erie Railway, which line had been laid for some time, but was in a constant state of rupture from the causes hereinbefore mentioned.

The result of the working of this machine was to revolutionize the en-

tire transportation of petroleum. It exceeded even the maker's anticipations. The action of this pumping engine under these severe conditions was as quiet and as free from harshness of motion as could be desired. The movement of the column of oil through the pipe was uniform and constant, and whereas under the old system of single cylinder pump the column of oil came to a stop at the end of each stroke, with a variation of pressure on the gauge of several hundred pounds, with the Worthington type there was no stoppage, but a constant flow from the starting to the stopping of the engine, and an almost uniform pressure on the gauge.

From 1878 to 1881–82 the building of the trunk lines to the seaboard was continuous, and refining of oil in the oil regions proper either remained stationary, or, as the different refineries were destroyed by fire (a fate which overtakes them all sooner or later), refining was discontinued, while on the seaboard and lakes large and extensive refineries were erected.

The Worthington type of pumping engine is used exclusively on the pipe lines of the National Transit Company. The engines vary in size according to the condition of service under which they are placed. On the New York and Pennsylvania lines, the most refined types of compound condensing engines are in use. On the Buffalo, Cleveland and Pittsburgh lines, compound non condensing engines are employed, while for the local lines a plain high-pressure pump is adopted. The average amount pumped per day through the New York lines is about 28,000 barrels, and the average head due to friction and elevation is about 900 pounds, sometimes rising to 1,200 and 1,500 pounds, depending, of course, on the piston speed of the pump.

At the different pumping stations are located one or more receiving tanks made of light boiler plate, dimensions 90 feet diameter by 30 feet high, and the oil is pumped from tanks at one station to tanks at the next, though there have been cases where loops have been laid around stations, and oil has been forced a distance of 110 miles with one pumping engine. Duplicate pumping engines are located in each station, so that there may be no cessation in pumping, one engine being in constant service.

The engines on the main 6-inch lines are from 600 to 800 horse power, while those on the 4-inch and 5-inch lines are from 150 to 200-horse power, and the local lines from 25 to 30 horse power. The pipe is made especially for the service, is lap-welded wrought iron of selected material, tested critically before leaving the mills, and is known to the trade as oil-line pipe. The lengths of 18 feet are fitted at each end with coarse and sharp-cut taper threads nine to the inch, and with long sleeve couplings also screwed taper. The taper is usually ¾ inch to the foot for 4-inch pipe.

The usual way of threading iron pipe is to cut the threads straight or parallel; as a consequence only three or four threads come in contact with the thread of the socket, or help in any way to assist in making the joint.

With a taper socket, the contact is perfect throughout the whole length of the thread on the pipe, thus making a tight joint.

The lines are usually laid 2 or 3 feet below the surface of the ground, and from time to time bends are made in the pipe to allow for expansion and contraction, thus dispensing with expansion joints.

Numberless creeks and rivers are crossed by the different lines, some on trestle bridges, others by laying the pipe at the bottom of the river, with a bend up stream. In crossing the Hudson and East rivers at New York city, quite an engineering feat was performed, as both rivers are very deep at this point, and the tide very rapid.

The lines have become obstructed from time to time by the precipitation of paraffine, which, adhering to the pipe, reduced its area, and consequently the delivery of oil materially. A novel device is used for removing the paraffine or other obstruction. It is known to the employees as a "Go Devil," as it travels through the pipe at the same speed as the oil, being propelled by the pressure transmitted from the pumps, and as its position can only be located by its noise in motion, it has to be followed by relays of men, for should it stop unnoticed, the pipe would have to be cut to locate it.

The reduction in cost of transportation of oil by pipe is not known absolutely, as the system is in the hands of a close corporation, whose financial statements are not public property, but, having the particulars as to engines employed, miles of pipe, and conditions of service, it is easy to see that a vast reduction in the cost of transportation of oil has been effected. Certainly among other benefits that arise from this change of methods of transportation, one great danger to the traveling public has been avoided—*i. e.*, the constant liability of railway trains and barges containing crude petroleum being destroyed by fire in transit, thereby endangering the lives of passengers on passing trains and boats, with consequent loss of property, as well as blocking for a time the most important trunk lines of railway.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE thick and thin advocates of municipal lighting stations (particularly if the latter are of the electrical type) have never been noted as very close figurers in respect to the cost of the operation of such establishments, unless it be that the "closeness" of their estimates rests on a decided predilection to eliminate as many items of expense as it is possible to do away with. A rather amusing warfare of words is going on now between the supporters of the municipal electric lighting station at Marietta, Ohio, and those who defend the contract in force between the authorities and the local electric lighting company at Parkersburg, Va. As these places are but about 12 miles apart, and on the same highway, it is fair to assume that what applies to the one place in the matter of the cost of operating electric lighting plants, would apply with equal force to the other. In any event the following, from the columns of the Parkersburg *Journal*, will furnish quite some instruction as to the true inwardness of the cost to Marietta of the lighting service obtained from Marietta's venture in the field of electric light supply. The *Journal* says: "The published reports of the cost of running the electric lights at Marietta, Ohio, for one year ($1,825), and our comments on the same, have called out further comments by the Marietta *Register*, which says: 'But, while the sum of expenses for salaries, repairs, etc., is about $1,850, there are two items, at least, not considered—interest on the bonds and depreciation on the plant. We believe our plant has been carefully handled and not strained. Still, 10 per cent. per annum on such equipments is not too much. It is great for the engine or the dynamo, but not enough for the wire. Add these to this cash outlay of interest and expenses, and it will run the cost up to about or quite $3,600. Parkersburg runs all night; we run to midnight, and not at all in full moon.' Yes; and investigation discloses the fact that Mr. Hancock, the Superintendent, worked the first year without pay, and that hereafter he is to get $840 a year. The Marietta plant furnished 1,650 hours of lighting, an average of 4½ hours per day, as against 4,069, an average of 11½ hours per day at Parkersburg. Marietta also uses city prisoners for handling coal, etc. Taking the *Register's* figures of $3,600 for last year, and adding the Superintendent's salary, etc., we get the cost for an average year, for 61 lights (not 67 lights, since 6 were only recently added), at $4,500. Parkersburg has 58 lights, costing $6,264. But this includes $12 a year for each patent mast arm, which the city can drop at the end of three years from date of contract, if it so desires. But taking the cost at $4,500 for Marietta and $6,264 for Parkersburg, and reducing this to the cost per lamp per hour, we find that Marietta is paying 4½ cents per lamp per hour against Parkersburg's 2⅝ cents per lamp per hour. If we properly exempt the mast arm rentals, Parkersburg is paying 2½ cents per lamp per hour. This showing for the Parkersburg Company puts quite a different phase on the matter if the Marietta *Register* gives the correct basis to figure on, *plus* the Superintendent's salary. Officials of the Parkersburg plant think that, on a fair estimate for expense, the cost per hour per lamp (61 lamps) at Marietta would be 2¾ cents."

THE residents of New Bedford (Mass.) are complaining loudly over the increased price demanded for an incandescent electric lighting service since the absorption by the Gas Company of the local Edison Electric Light Company. It is said that the increased rate amounts to an average of 40 per cent., which, while seemingly high, is in reality only barely sufficient to enable the service to be carried on without actual loss to the Company. The agitation is but the necessary outcome of the rate warfare when the Edison folks were attempting to "down" the Gas Company.

WE are indebted to a Pawtucket (R. I.) correspondent for the following from a recent issue of the Pawtucket *Times:* "If any of the hundreds who grumbled at the heat could have taken a trip through the works of the Pawtucket Gas Company this morning they would have quickly decided that in comparison with some portions of the atmosphere in that establishment the air on the streets was simply refreshing. About the retorts the men worked, utterly indifferent to what seemed to a *Times* representative a state of torridity beside which even the imaginative infernal regions would be almost ice palaces. Outside the scene was one of great activity, for a hundred men were engaged upon different sections of what, when completed, will be an immense addition to the Company's plant, besides being of great benefit to every consumer of gas in the city. As is well known, the Company has for some time been engaged in making preparations for the manufacture of water gas. The works are now almost completed, and through the courtesy of Superintendent S. G. Stiness a representative of the *Times* inspected the plant this morning. Comparatively speaking, but very few people know

what water gas is. Practically it is the destructive distillation of superheated steam, which is resolved into hydrogen and carbonic oxide, to which is added the rich vapors of oil decomposed by heat, whereupon a high candle power illuminating gas is produced. The object of its manufacture in Pawtucket is to add increased brilliancy to the gas now used, and in order to accomplish that object the Company is expending $35,000. When the works are completed, as they soon will be, every gas consumer in this city will at once see the benefit in the increased brilliancy of the gas which he uses. The new brick building with the tall chimney which travelers on the river boats notice as they pass up and down is the room where the water gas is to be generated. Its inside dimensions are 75 by 33 feet, and it is fitted up for two sets of apparatus, though but one is to be used at first. There is a large boiler room containing two 50-horse power engines, and a chimney 50 feet high furnishes draught. The apparatus for manufacturing the water gas is all at hand. There is a generator, carburetor, superheater, washer, scrubber and condenser. The system is that of the United Gas Improvement Company. In the rear of the new building the scene looks like a small quarry. There an army of workmen are engaged. Some are blasting rocks, others digging away the small pieces, and still others lifting the large pieces out with a derrick. There the Company will have its relief holder for the water gas plant. After the rocks are blasted and the place all prepared a circular iron covering will conceal it from view, as it does the present tank beside which it is being located. As said before, it is the introduction of the oil vapors into the water gas that gives it illuminating power. The elements of oil and steam are united in the machine called the carburetor, where they are made into fixed gas. The plant when completed will be capable of producing 250,000 cubic feet of water gas per diem. The present capacity of the coal gas plant is 800,000 cubic feet per diem. The plan of the Company is to use one-quarter water gas with the coal gas now produced. The result will be to provide the present coal gas with a much higher illuminating power. An idea of the increased brilliancy which ordinary gas acquires by the introduction of water gas can be ascertained by the statement that gas of 10-candle power can be given a 30-candle power by the addition of the water gas. In other words, the gas as at present used would receive an added brilliancy of 3 times that possessed at present. The whole plant is of great interest, and will be a great addition to what is now a first-class plant in every respect. A tour through the works was taken under the guidance of Mr. Irving Pratt. In the retort room the men worked about the immense furnaces without apparently noticing the great heat. As the men fed the great openings a helper would step to them and calmly fasten on the covers, notwithstanding that the flames rushed out in great volume, seemingly directly in his face. All portions of the works are models, and Pawtucket may congratulate itself on having one of the finest equipped gas works in the country."

THE Pawtucket *Times*' man, in the foregoing, managed to come out of the ordeal fairly well, but we may perhaps be forgiven for calling his attention to a possible error in his suggestions as to the future candle power of the gas which it is the intention of Mr. Stiness to supply or distribute in that city. There can be no doubt about the fact that it is possible to bring a 10-candle power coal gas up to 30 candles by the admixture with it of the necessary volume of an excessively rich water gas; hence, that part of his calculation is all very well. However, remembering that Mr. Stiness has made it the rule to always distribute a good article of coal gas—we are quite sure that it will have averaged 18.5 candles—we are inclined to the belief that that he told the *Times*' man the new product's value in candles might be one-third greater than that which it was destined to supersede. And it ought to satisfy the Pawtucket people very well, at that.

THE proprietors of the Bayonne and Greenville (N. J.) Gas Company have placed two large gas lamps, fitted with the Gordon type of street burner, in front of the local City Hall. The lamps are attracting much attention, and it is not at all improbable that the authorities will decide to introduce the Gordon lamp as a means of illuminating some of the most prominent street intersections. We believe the Gordon lamp has a great future in store for it as a public lighting agent.

MR. G. A. WHITNEY, well known from his connection with the Woodbury (N. J.) Company, died at Cape May, on the 29th ult.

THE Directors of the Oakland (Cal.) Gas Company have issued a call for a special meeting of the shareholders to be held on September 22d, for the purpose of determining whether a bond issue of $1,000,000 shall be made. As it is likely that the stockholders will indorse the proposal, there can be no harm now in saying that $350,000 of the new issue will be devoted to the retirement of the present bonded debt, that $150,000 be expended in plant betterments, and that the balance will be held in the treasury. The Company has been obliged to make arrangements of this nature on account of the greatly increased demands on its resources for more light. The Alameda, Fruitvale and Berkeley districts are growing rapidly. The electric lighting portion of the Company's business will also share in the betterment plans.

GENERAL HICKENLOOPER'S Company is again to be the subject of "investigation," at least such would seem to be the case from the following information that comes to us by way of Cincinnati, under date of July 29th: "Messrs. Kerper and Allison were absent from the meeting of the Board of Public Improvements yesterday morning, and the following significant resolution was introduced by President Reemelin, and passed by the Board: '*Resolved*, That this Board, on Tuesday, August 5th, will take up the question as to the best mode and manner to investigate the supply and quality of gas being furnished the city by the Cincinnati Gas Light and Coke Company under its contract as to whether it is living up to its contract.' For some time there has been an undercurrent of feeling growing in the breasts of certain members of the Board regarding the Gas Company, which is an undoubted power in that city. This feeling has developed into a desire to know whether the relations existing between the Company and the municipality are not unduly favorable to the former, hence the proposed investigation."

WE are more than pleased to find that certain members of Cincinnati's local government have at last reached that stage of intelligence where they acknowledge that the local Gas Company has become an undoubted power in their city. Every gas man in the United States has for some years known that the Cincinnati Gas Light and Coke Company was "a power for good," both in its influence at home and its example abroad. The General, no doubt, by this time has said to the B. P. I., "Gentlemen, bring on your investigators!"

MESSRS. JAS. A. BRADLEY, John E. Ridall, E. L. Maxwell, E. F. Houston and William Barker have incorporated the Bradley-Barker Manufacturing Company, of Pittsburgh, Pa. They propose to manufacture and deal in gas regulators and gas works supplies.

THE Mayor of St. Louis, in his annual message, claims that St. Louis is the best lighted city in the country. Under the electric lighting contracts now in force we are told that the following lamps have been put in service: Arcs, for streets and avenues, 1,552; incandescent lights, for alleys, 1,462; arcs, for public buildings, 30; incandescent lights, for public buildings, 3,442.

IT is reported that the Annapolis (Md.) Gas Light Company has been sold to Baltimore capitalists, the negotiations having been conducted by Messrs. John S. Gittings & Co., of that city.

AN English correspondent, in commenting on the recent advances that have been made in the prices of gas coals on the other side of the water, writes: "There is a strong feeling abroad that the tenders sent in to the leading gas companies, for their supply of fuel for the ensuing year, are much higher than are warranted by the state of trade, including the wages paid to colliery employees. It is generally believed still that the gas companies make increased profits by advancing their prices to consumers, whenever coal is supplied to them at a higher rate than previously, but this is really the reverse of truth. It has been estimated that with a yearly output of coal in the whole country at 170,000,000 tons, and taking the 35 per cent. on wages into account, there would be an extra payment on the latter account of £225,000 weekly, or 11¼ millions sterling per year. This is certainly a very large sum to be paid above the rate of wages which prevailed in 1888. Assuming, then, that the gas companies took one-ninth of all the coal raised in the Kingdom, their proportion of the 35 per cent. increased wages should not be more than £1,250,000. But if the general advances in the price of coal to gas companies are taken as low as 1s. 6d. per ton in 1889, and the same in 1890, or a total of 3s. per ton (which is very far below the actual charges), then the gas companies will be paying, in connection with the advances in wages, not less than £2,550,000 out of a total of £11,250,000. This, to say the least, is out of all proportion to what it ought to be; but the probabilities are that the gas companies are now paying in the aggregate considerably more than £3,000,000 annually in consequence of the advance in the price of coal. It would seem, indeed, that the price of gas and household coal has been put up at the rate of some-

thing like £27,000,000 per annum, so that coal owners are reaping more than 100 per cent. of the increase themselves."

MR. WILLIAM BOSLEY will be elected President of the Annapolis (Md.) Gas Light Company by the Baltimore syndicate that recently purchased its property and franchises. The first payment on the purchase was made on August 1st. The new proprietors will make important betterments on the property.

A PLOT of land has finally been purchased for the location of the manufacturing plant of the new Gas Company for South Framingham, Mass. Mr. William Tarbell has been appointed Superintendent of construction, and he will be assisted by his son. The holder capacity arranged for is equivalent to the storage of 60,000 cubic feet.

"THE people of New Bedford (Mass.) who have had electricity of the incandescent type for almost the asking, prior to the consolidation of the Edison Company with the Gas Company, now that they are obliged to pay something like a reasonable price for the service, are shouting wildly about 'monopoly,' 'rascally greed,' etc. If the shouters would only take their trusty lead pencils and figure out just what the current prices for incandescent electric lighting are, when compared with an equal lighting service with gas as the medium, they would find the situation to be about as follows: On bills for less than $8 per month, the rate is equivalent to gas at $1.90 per 1,000; on bills from $8 to $16, the electric rate is equivalent to a gas rate of $1.70 per 1,000. Beyond a doubt, these are reasonable charges, and show the hollowness of the 'public voice,' which in money matters of this nature will never assume other than a rasping sound. Quite sensibly, too, the Company has determined to render the bills monthly, and not enter into any contracts.—OBSERVER."

MR. RALPH WOODWARD has resigned his position as Assistant Superintendent of the Waltham (Mass.) Gas Company. We hope he does not mean to remain out of harness for any length of time.

COL. N. M. JONES, of the Memphis (Tenn.) Gas Light Company has presented the city with a photometer to be used by the authorities in testing the candle power of the gas supplied for public purposes. Mr. H. J. Lynn, Jr., was thereupon appointed official Gas Inspector, at a salary of $25 per month.

THE Equitable (Memphis, Tenn.) Gas Light Company has been awarded a contract for the public lighting at the rate of $1 per lamp per month. The bills are made out on a basis of 496 lamps, with a pro rata reduction whenever it is shown that the gas is not up to the standard of 20 candles.

IT is quite likely that the properties and business of the Woodstock (Ont.) Gas and Electric Light Companies will be amalgamated.

JOHN NOLAN was awarded the contract for excavating the tank to receive the new gasholder to be erected by the New Britain (Conn.) Gas Company.

MR. G. S. MELCHER is no longer in charge of the electric station of the Brookline (Mass.) Company.

AT the annual meeting of the Northampton (Mass.) Gas Company the following officers were chosen: Directors, J. F. Starr (Camden, N. J.), M. M. French, L. Clark Seelye, D. W. Crafts and Geo. P. Dickinson; President, M. M. French; Clerk and Treasurer, Geo. P. Dickinson; Supt. D. W. Crafts. A semi-annual dividend of 4 per cent. was declared. A very large increase in sendout (about one million cubic feet) was reported for the twelvemonth.

AT the annual election of the Pittsfield (Mass.) Coal Gas Company no change was made in the management. The capital stock was increased from $62,500 to $87,500.

THE proprietors of gas works within a radius of 100 miles of this city who have not made arrangements for the disposal of their ammoniacal liquor may find it profitable to communicate with us in respect to its disposal. State the quantities that can be relied on for immediate monthly shipment, strength, etc.

THE assets of the Citizens Gas Light Company, of Quincy, Mass., are returned at $74,534. This sum includes a good-sized cash balance.

IT is not at all certain that the controlling interest in the Natick (Mass.) Gas Company is owned by the Thomson-Houston Company.

ADVICES from Baltimore, Md., under date of August 1, are to the effect that, on July 31, Judge Horton, in Chicago, rendered a decision rescinding the contract between Nicholas C. Miller and Columbus R. Cummings for the sale to the latter of a majority of stock of the Lake Gas Company, owned by Miller. The sale was made March, 1887, and Miller exchanged 2,842 shares of the Lake Company for $142,000 cash and 2,130 shares of the Chicago Gas Trust Company. Cummings subsequently sold the Lake Company to the Consumers Gas Company for $356,000 of its first mortgage bonds, and netted over $40,000 over and above what he paid Miller. Miller filed a bill to rescind the contract on the ground of fraud. He claimed that Cummings made misrepresentations to him on a number of material points. For instance, it was told him, he claims, that the Gas Trust Company, $213,000 of whose shares he received in part payment for the Lake Company, was to be capitalized for only $15,000,000, whereas it was capitalized for $25,000,000, and his dividends on his stock cut down to about half of their value. Miller also said he was told that the $213,000 of Gas Trust stock was to be fully paid up, whereas little or nothing had been. The Court, after an exhaustive review of the evidence, which he found to be difficult of reconciliation and conflicting, found that fraud was practiced on Miller; that it was fraud upon Miller to formally organize a Company and deliver to him stock as fully paid up when scarcely anything had been paid. It was also not told Miller that the capital stock of the Gas Trust Company was encumbered by the guarantee of that Company to pay all the bond obligations of the Companies composing it, amounting to over $17,000,000. Other material facts were also said by the Court to have been suppressed from Miller, and Judge Horton said that the Supreme Court having held the Gas Trust illegal, the stock given Miller in part payment of the Lake Company was void, and Miller was not obliged to accept null and void certificates of stock, The fact was that the Gas Trust Company had not and never had any legally acquired assets, although it issued $25,000,000 of capital stock. Concluding, the Court said: "The Court is of opinion that misrepresentations were made to the complainant, and notice of material facts improperly withheld, and that there were such frauds in law as require a recision of the contract. I find nothing in the evidence connecting the defendant, Kent, with the frauds or with notice thereof, and a decree will not go personally against him. The decree will be that Cummings deliver to Miller the full amount of Consumers bonds received by him for Lake Company stock sold to him by Miller, or a cash equivalent, upon the return of the $142,000 cash and $213,000 stock of the Gas Trust Company received by Miller." The Consumers Gas Company and Cummings, the principal defendants to the suit, will appeal. Miller had borrowed $100,000 from S. A. Kent and Cummings, which he is required to refund. The defendants offered to restore the Lake Company to Miller, but the Court held that could not be done, some of the Company's property having been sold.

IT is possible that the Sante Fe (New Mexico) Gas Company will engage in the electric lighting business.

THE Birmingham (England) Gas Committee will have, owing to the increased rates for coal over the contracts for that material recently completed, to pay $200,000 more on coal account than was paid two years ago.

A COMMITTEE of the North British Association of Gas Managers recommends the following pipe sizes for domestic gas distribution—no quarter inch to be used:

Internal diameter of pipe, inches....	⅜	½	⅝	¾	1	1¼	1½	2
Greatest length of pipe allowed, feet.	20	30	40	50	70	100	150	200
Greatest number of burners for size and length of pipe	3	6	12	20	35	60	100	200

ON the 5th inst. the proprietors of the Laclede Gas Light Company began work on the plant of the Pintsch type, from which it is propoeed to supply compressed oil gas for the illumination of the passenger coaches of certain lines that arrive and depart from the Union Depot, St. Louis.

IF nonilluminating water gas was not successfully introduced at St. Louis, by the Laclede Gas Light Company, this summer, the success of ordinary illuminating gas as a fuel for domestic purposes was unequivocal. The Company has placed over 1,000 cooking stoves since the 1st of May.

THE generating house of the Waterloo (Iowa) Gas Company was badly damaged by fire on the afternoon of July 31st.

THE City Engineer of Toronto (Can.) has issued an order that no more than 150 feet of any street shall be opened at any one time for the burying of gas mains, etc.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

August 11.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	100	—
Central	500,000	50	85	95
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	127	130
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	115	—
Mutual	3,500,000	100	123	125
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co —				
Common Stock	5,000,000	100	—	45
Preferred	5,000,000	100	84	87
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	118	122
Citizens	1,200,000	20	90	—
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	144	146
" Bonds	300,000		10)	105
Peoples	1,000,000	10	95	100
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	109	111
Nassau	1,000,000	25	130	—
" Ctfs	700,000	1000	100	102
Williamsburgh	1,000,000	50	131	—
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co. —				
1st Series S.F. Trust	7,000,000	1000	93	93½
2d " " "	3,000,000	1000	71	72
Bay State Gas Co. —				
Stock	5,000,000	50	85	86
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Company	25,000,000	100	53½	—
Chicago Gas Light & Coke Co. —				
G't'd Gold Bonds	7,650,000	1000	90	92½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	94½	95½
People's Gas and Coke Co., Chicago —				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	96	100

Advertisers Index.

GAS ENGINEERS.

Page

Jos. R. Thomas, New York City ... 205
Wm. Henry White, New York City ... 211
Wm. Mooney, New York City ... 205
William Gardner, Pittsburgh, Pa. ... 205
Fred. Bredel, N. Y. City ... 207

GAS AND WATER PIPES.

Gloucester Iron Works, Phila., Pa ... 205
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) ... 205
Ohio Pipe Co., Columbus, Ohio ... 205
M. J. Drummond, New York City ... 205
R. D. Wood & Co., Phila., Pa ... 210
Warren Foundry & Machine Co., New York City ... 205
Donaldson Iron Co., Emaus, Pa ... 205
Dennis Long & Company, Louisville, Ky ... 205
Spiral Weld Tube Company, New York City ... 205

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 211
Continental Iron Works, Greenpoint, L. I ... 211
Delly & Fowler, Phila., Pa ... 211
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 208
Stacey Mfg. Co., Cincinnati, Ohio ... 211
Bartlett, Hayward & Co., Baltimore, Md ... 209
Morris, Tasker & Co., Limited, Phila., Pa ... 209
Davis & Farnum Mfg Co., Waltham, Mass ... 208
R. D. Wood & Co., Phila., Pa ... 210
Bouton Foundry Co., Chicago, Ills ... 211
Smith & Sayre Manufacturing Co., New York City ... 210
Fred. Bredel, N. Y. City ... 207
United Gas Improvement Co., Phila., Pa ... 201
National Gas Light and Fuel Co., Chicago, Ills ... 198
Simpkin & Hillyer, Richmond, Va ... 195
Berlin Iron Bridge Company, East Berlin, Conn ... 158

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills ... 198
Bartlett, Hayward & Co., Baltimore, Md ... 209
Wm. Henry White, N. Y. City ... 211
United Gas Improvement Co., Phila., Pa ... 201

INCLINED RETORTS.

Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 195

GASHOLDER TANKS.

W. C. Whyte, New York City ... 198
J. P. Whittier, Brooklyn, N. Y ... 203

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass ... 197

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J ... 206
B. Kreischer & Sons, New York City ... 206
Adam Weber, New York City ... 206
Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 206
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 206
Borgner & O'Brien, Phila., Pa ... 206
James Gardner, Jr., Pittsburgh, Pa ... 206
Henry Maurer & Son, New York City ... 207
Chicago Retort and Fire Brick Co., Chicago, Ills ... 206
Baltimore Retort and Fire Brick Co., Baltimore ... 206
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo ... 206
Boston Fire Brick Works, Boston, Mass ... 206

SCRUBBERS AND CONDENSERS.

G. Shepard Page, New York City ... 200
R. D. Wood & Co., Phila., Pa ... 210
James R. Floyd & Sons, New York City ... 204

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 209
Fred. Bredel, New York City ... 207
Chicago Retort and Firebrick Co., Chicago, Ills ... 206
J. H. Gautier & Co., Jersey City, N. J ... 207

GAS GOVERNORS.

Connelly & Co., New York City ... 203
Fred. Bredel, N. Y. City ... 207
Friedrich Lux, London, England ... 196

SELF-SEALING MOUTHPIECE DOORS.

Smith & Sayre Mfg. Co., New York City ... 210

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page, N. Y. City ... 164

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y ... 206

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio ... 212

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 214
American Meter Co., New York and Philadelphia ... 215
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 215
Helme & McIlhenny, Phila., Pa ... 215
D. McDonald & Co. Albany, N. Y ... 215
Nathaniel Tufts, Boston, Mass ... 214
Maryland Meter and Manufacturing Co., Baltimore, Md ... 158
Jones Meter and Stove Co., Royersford, Pa ... 214
Harris Bros. & Co., Philadelphia, Pa ... 214

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind ... 202
Smith & Sayre Manufacturing Co., New York City ... 210
Wilbraham Bros., Philadelphia, Pa ... 203
Connelly & Co., New York City ... 203

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 213
Perkins & Co., New York City ... 212
Despard Coal Co., Baltimore, Md ... 213
Chesapeake and Ohio R. R. Coal Agency, N. Y. City ... 213
Westmoreland Coal Company, Phila., Pa ... 213
J. & W. Wood, New York City ... 212

CANNEL COALS.

Perkins & Co., New York City ... 212
J. & W. Wood, New York City ... 212

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 195
John McLean, New York City ... 195
Chapman Valve Manufacturing Co., Boston, Mass ... 195
R. D. Wood & Co., Phila., Pa ... 210
The P. H. & F. M. Roots Co., Connersville, Ind ... 202

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa ... 216
Clerk Gas Engine Co, Phila., Pa ... 213
Van Duzen Gas Engine Co., Cincinnati, Ohio ... 213

ENGINES AND BOILERS.

Jarvis Engineering Co., Boston, Mass ... 203

STEAM PUMPS.

Van Duzen & Tift, Cincinnati, Ohio ... 195

GAS LAMPS.

Welsbach Incandescent Gas Light Co., Phila., Pa ... 197
The Siemens-Lungren Company, Philadelphia, Pa ... 197
Fiske, Coleman & Company, Boston, Mass ... 206

PURIFIER SCREENS.

John Cabot, New York City ... 196
Bartlett, Hayward & Co., Baltimore, Md ... 196

GAS STOVES.

American Meter Co., New York and Philadelphia ... 199
The Goodwin Gas Stove and Meter Co., Phila. Pa ... 180
George M. Clark & Company, Chicago, Ills ... 198
D. McDonald & Co., Albany, N. Y ... 215
Maryland Meter and Manufacturing Co., Baltimore, Md ... 158
Jones Meter and Stove Co., Royersford, Pa ... 214
Chicago Gas Stove Company, Chicago, Ills ... 196
Dangler Stove and Mfg. Co, Cleveland, Ohio ... 196

STREET LAMPS

J. G. Miner, Morrisania, New York City ... 197
Bartlett Street Lamp Man'fg Co., New York City ... 197

BURNERS

C. A. Gefrorer, Phila., Pa ... 212
Moses G. Wilder, Phila., Pa ... 197

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City ... 171

PURIFYING MATERIAL.

Connelly & Co., New York City ... 203
Friedrich Lux, London, England ... 196

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 213

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City ... 211
Fort Wayne Electric Co., Fort Wayne, Ind ... 201

BOOKS, ETC.

1890. Directory. 1890 ... 203
King's Treatise ... 205
Practical Electric Lighting ... 203
Electric Light Primer ... 2 2
American Gas Engineer and Superintendents' Handbook ... 165
Digest of Gas Law ... 207
Fuel and its Applications ... 195
Newbigging's Handbook ... 2 7

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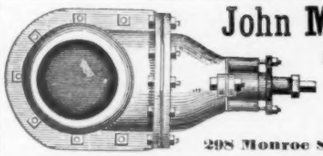
Also, Gate Fire Hydrants With and Without Independent Nozzle Valve. All Work Guaranteed.

WORKS & GEN'L OFFICE: Indian Orchard, Mass.
TREASURER'S OFFICE: 72 Kilby & 112 Milk Sts, Boston, Mass.



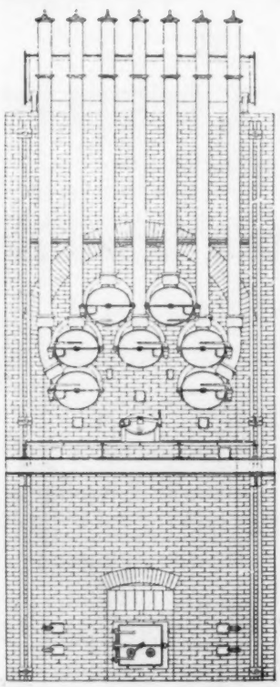
John McLean

Man'facturer

GAS VALVES.

298 Monroe Street, N. Y

LACLEDE FIRE BRICK MANUFACTURING COMPANY,



ST. LOUIS, MO.

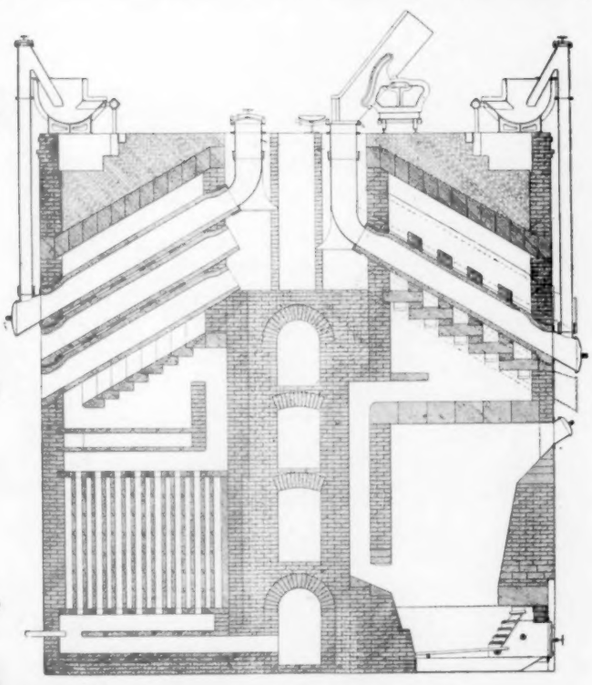
Exclusive Agents in the United States

FOR THE

Coze System of Inclined Retorts.

IT IS THE COMING BENCH FOR MAKING COAL GAS.

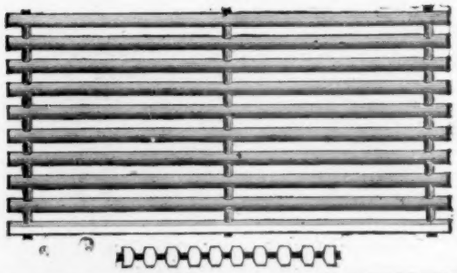
It will Save from 50 to 60 per ct. in Labor.



ESTIMATES AND PLANS FURNISHED BY THE

LACLEDE FIRE BRICK MFG. CO., ST. LOUIS, MO.

MILLS' REVERSIBLE LIME TRAY,



AND

WOODWORK

Of Every Description

NEEDED BY GAS WORKS.

SEND FOR CIRCULAR AND PRICE LIST TO

BARTLETT, HAYWARD & CO.,

Pratt and Scott Streets, Baltimore, Md.

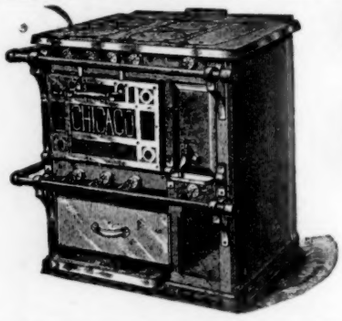
SPECIAL TRAYS FOR IRON SPONGE OR OXIDE OF IRON.

CHURCH'S TRAYS A SPECIALTY.

REVERSIBLE-STRONGEST-MOST DURABLE-MOST EASILY REPAIRED.

306-310 ELEVENTH AVENUE, NEW YORK.

WE ALSO MAKE THE CHEAPEST AND STRONGEST REVERSIBLE BOLTED TRAYS IN THE MARKET.



CHICAGO GAS STOVE CO.

MANUFACTURERS OF ALL KINDS OF

Gas Cooking and Heating

APPLIANCES.

117-119 Lake St., CHICAGO.

Send for Catalogue.

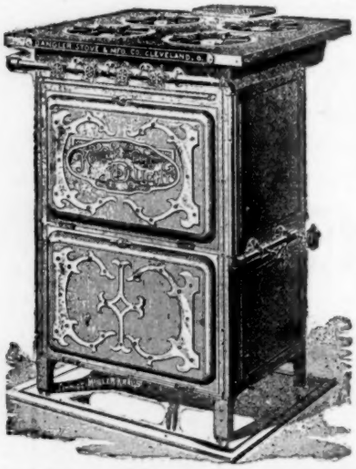
FRIEDRICH LUX,

Ludwigshafen am Rhein and London.

Lux Mass

GAS GOVERNORS,

Gas Balance.



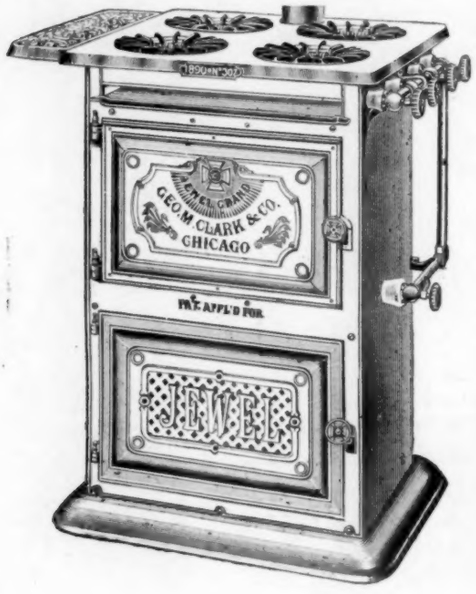
The Hot Water Problem Solved.

The most serious drawback to the general introduction and use of Gas for domestic purposes has been the supply of hot water. The only way of heating water heretofore has been by a separate attachment, which is both inconvenient and adds materially to the expense.

We are pleased to say to those interested that after many experiments we have been entirely successful in making a Gas Range with an ATTACHMENT FOR HEATING WATER AS A PART OF THE RANGE, direct from the burners, while the Range is being used for cooking and general domestic work, in the same manner as water is heated by the ordinary coal or wood range. A large number of these Ranges are now in DAILY USE, GIVING PERFECT SATISFACTION, not only for supplying hot water, but in all other respects. Our price and discounts to the trade are liberal and satisfactory. For further information address

THE DANGLER STOVE AND MFG. COMPANY,

Cleveland, Ohio.



JEWEL GAS STOVES

MANUFACTURED BY

GEORGE M. CLARK & COMPANY,

Nos. 157 & 159 Superior Street, - - - Chicago, Ill

EVERY CONCEIVABLE SIZE AND STYLE,

Ranging in Prices from $1.50 to $30.00.

WE USE NO GAS COCKS.

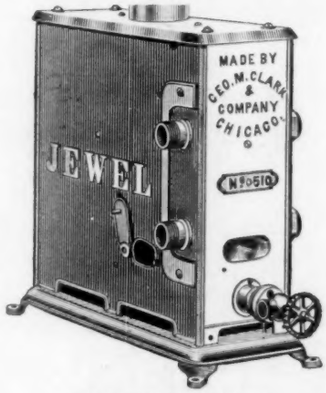
All Flames are Regulated by a Direct Needle Valve.

The JEWEL

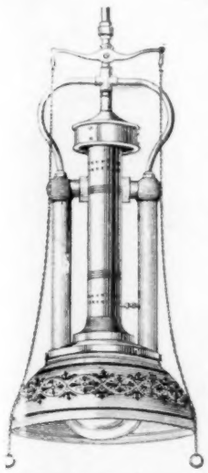
IS THE

Only Well-Made Gas Stove on the Market.

Write for our 1890 Catalogue and see for yourself.



Jewel Circulating Water Heater.



Gordon Portico Lamp.

The Gordon Portico Lamp.

A successful Competitor of the Arc Electric Light for lighting Store Fronts, Show Windows, Depots, Railway Sheds, etc., etc.

The Gordon Street Lamp.

A Successful Competitor of the Arc Electric Light for lighting Streets, etc., etc.

Gordon Street Lamp.

The Lungren Lamp.

A Successful Competitor of the Incandescent Electric Light for Interiors, etc. Is especially applicable for the lighting of Offices, Stores Factories, Mills, Show Windows, Libraries, and all situations where an increased illumination is desired.

More than 25,000 Lungren Lamps are now in use Testimonials, references, or any desired information will be cheerfully given.

Lungren Lamp.

THE SIEMENS-LUNGREN CO., Drexel Building, Philadelphia, Pa.

WELSBACH SYSTEM
OF
Incandescent Gas Lighting.

OFFICE, DREXEL BUILDING, PHILA., PA.

At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

MOSES G. WILDER, MECH. ENGR.

816-18-20-22 Cherry St., Phila., Pa.

Volumetric Lamp Governors

FOR GAS LAMPS & HIGH-POWER BURNERS.

Governor Burners for Street Lamps & General Use

GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

Horizontal Governors

Specially Adapted for Gas Stoves, Furnaces, etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

Correspondence Solicited with all who require a Reliable Governor.

Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

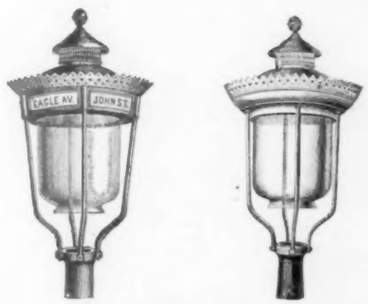
LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY.

Gas Companies and others intending to erect Lamps and Posts will do well to communicate with us.



The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

GASHOLDER PAINT.

Use Only

THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO., 122 Milk Street, Boston, Mass.

NATIONAL GAS LIGHT AND FUEL CO.,

218 La Salle Street, Chicago.

C. D. HAUK, Prest. & Gen'l Manager. A. W. GREEN, Vice-Prest. N. A. McCLARY, Sec. & Treas. E. E. MORRELL, Engr.

GAS WORKS

Built, Remodeled, Leased, and Purchased.

71 Springer Cupolas have been installed in the U. S. during the past four years.

The total capacity of Springer Apparatus now in use is over 25,000,000 ft. daily.

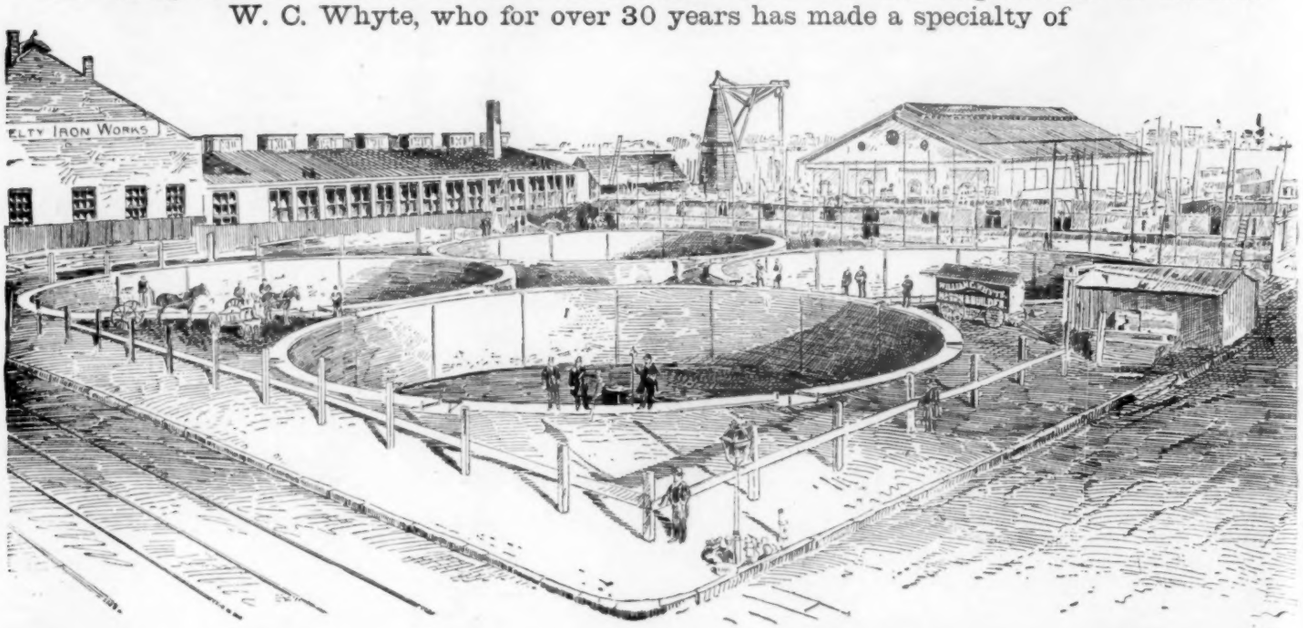
THE SPRINGER CUPOLA SYSTEM

Has Proven Itself the most Economical and Satisfactory Method of Gas Manufacture ever brought to the attention of the Gas Fraternity.

GUARANTEED ESTIMATES of Cost of Gas Furnished on Application.

GASHOLDER TANK CONSTRUCTION, ETC.

Gas Companies and others about to erect Gasholders will find it profitable to consult W. C. Whyte, who for over 30 years has made a specialty of



Tank Excavation and Mason Work.

Fifty Tanks now in operation show the sort of work done. Address

W. C. WHYTE. - No. 15 Cortlandt Street, N. Y. City.

GAS STOVES. GAS METERS. GAS STOVES.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

MANUFACTURERS OF

Standard 3 Diaphragm Dry Meter.

Gas Meters,

STATION METERS,

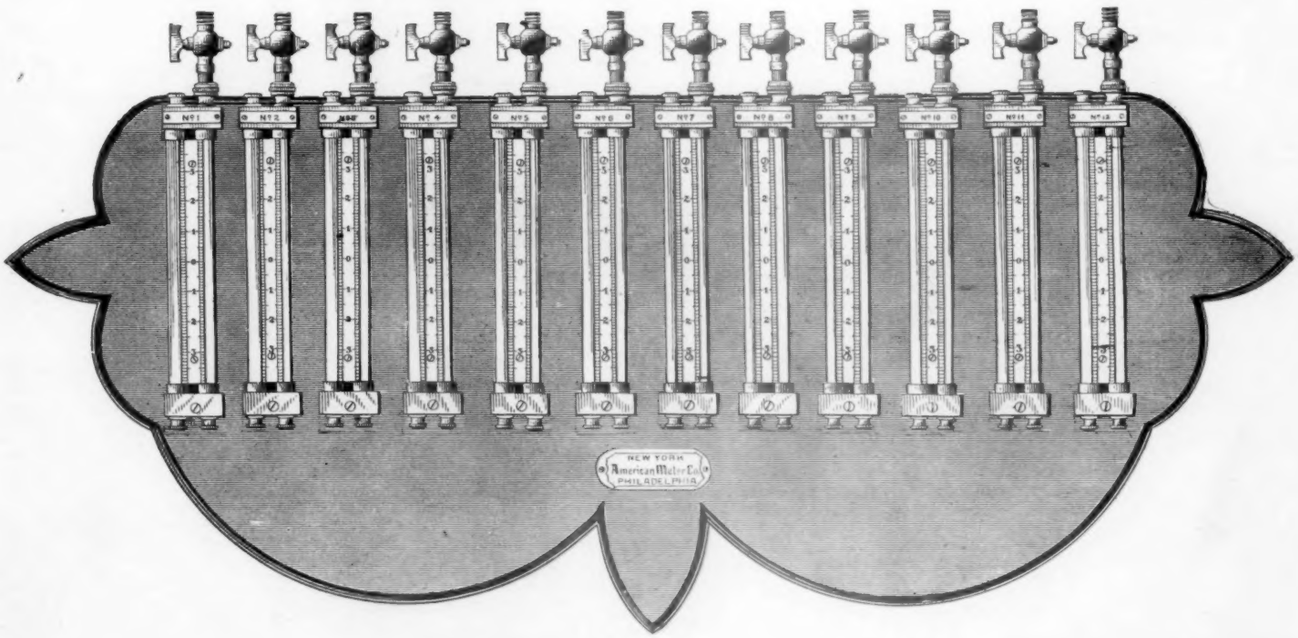
METER PROVERS, PHOTOMETERS,

Experimental Meters of all Kinds,

AND

Standard 2 Diaphragm Dry Meter.

Apparatus for Testing the Quantity and Quality of Gases.



Pressure Gauges of all Designs.

MANUFACTORIES,

508 to 514 West Twenty-second St, N. Y. Arch and Twenty-second St., Phila.

Nos. 244 & 246 North Wells Street, Chicago, Ill.

AGENCIES,

No. 177 Elm Street, Cincinnati, Ohio. No. 222 Sutter Street, San Francisco, Cal.

No. 810 North Second Street, St. Louis, Mo.

GAS STOVE SHOW ROOMS, No. 242 Sixth Avenue, New York City.

KIRKHAM, HULETT & CHANDLER, LIMITED.

PATENT "STANDARD" WASHER-SCRUBBERS

Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,0.0
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,0 0
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S A	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750 000
Edinburgh	1,500,000
"	2,000 000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150 000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3 000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	500,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1 500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1 500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W	100,000
Prescott	150,000
Providence, U.S.A	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300 000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
Yeovil	250,000

SOLE AGENT FOR WESTERN HEMISPHERE,

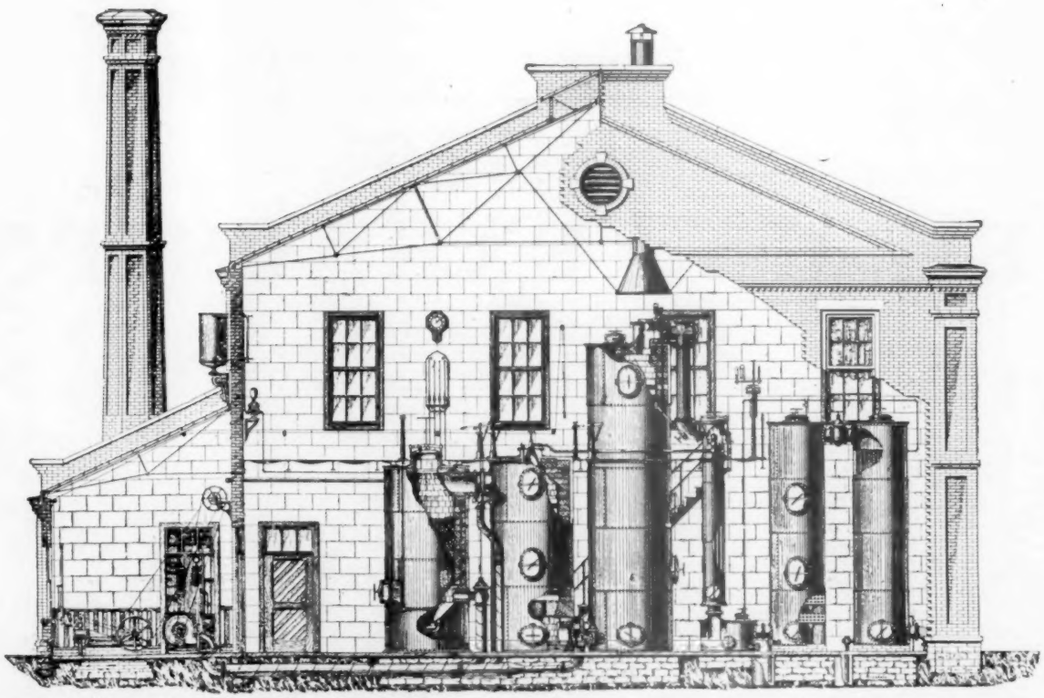
GEO. SHEPARD PAGE, 69 WALL STREET, NEW YORK

THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Owners of the Lowe, Granger-Collins, McKay-Critchlow (for carbureting Natural Gas), and Other Gas Patents.

BUILDERS, LESSORS and PURCHASERS OF GAS WORKS.



Standard "Double Superheater" Lowe Apparatus, Especially Designed for the Use of Lima Crude Oil.

Erectors of

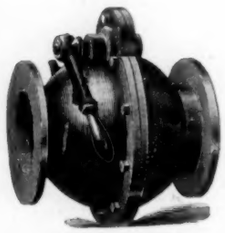
WATER GAS PLANTS,

(Either Independent or Auxiliary to Coal Gas Works),

USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE.

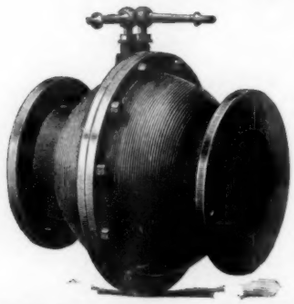
PAMPHLETS, PLANS, AND ESTIMATES FURNISHED UPON APPLICATION.

ROOTS'
GAS AND BYE-PASS VALVES.



GAS VALVE

Quick Acting,
Simple,
Efficient, Durable.



BYE-PASS VALVE.

Automatic Action
Reliable
Simple Durable.

Thousands now in use and giving perfect satisfaction. Write for Catalogue and Prices.

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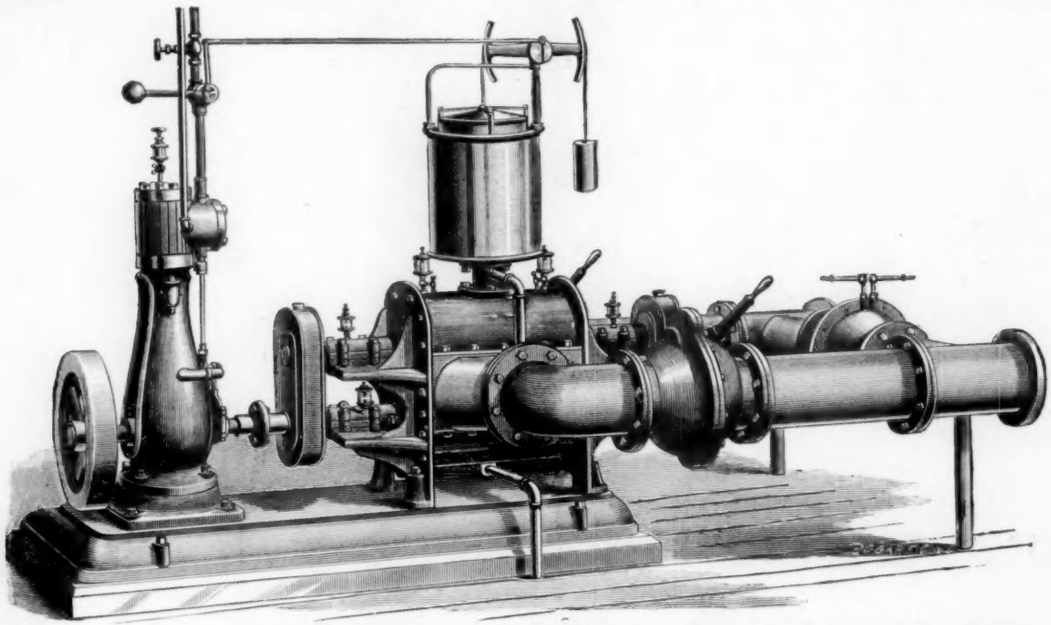

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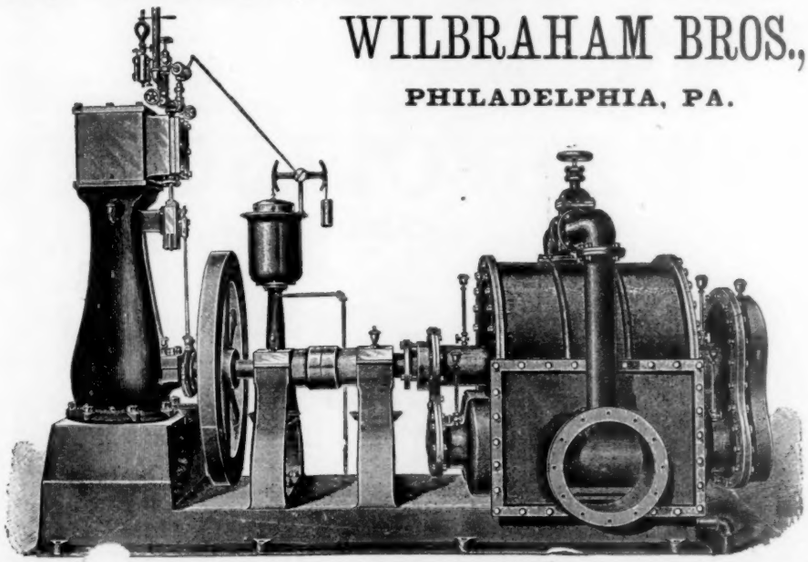

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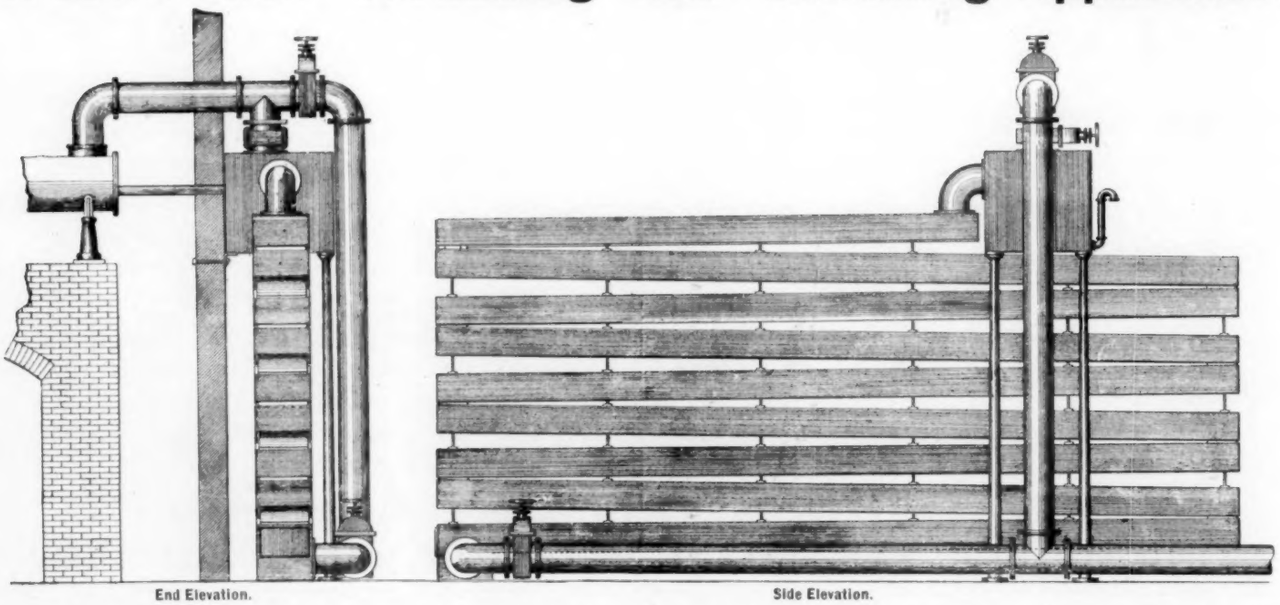

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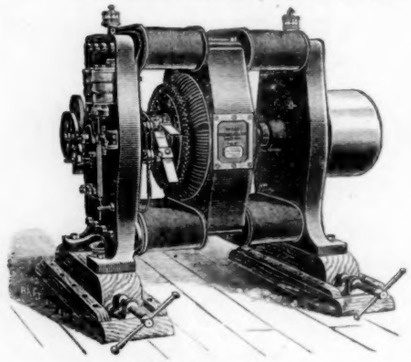

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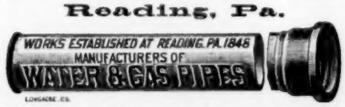

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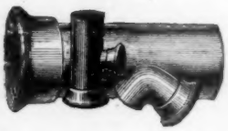

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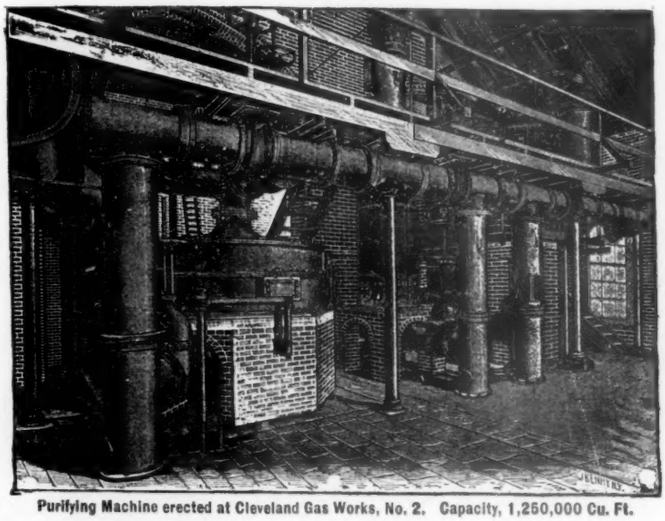

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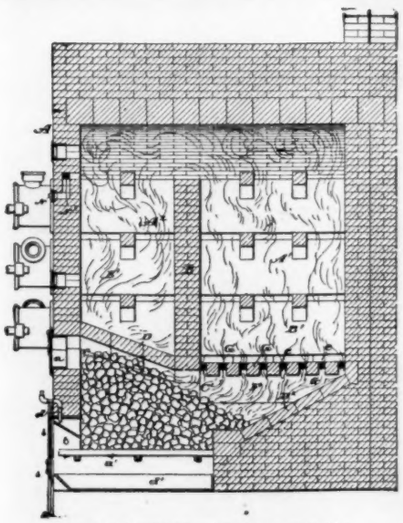

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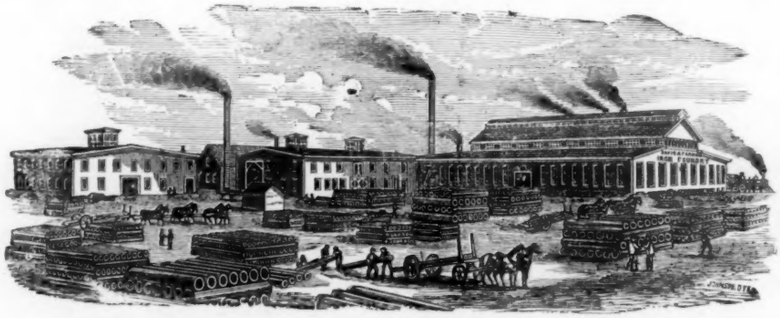

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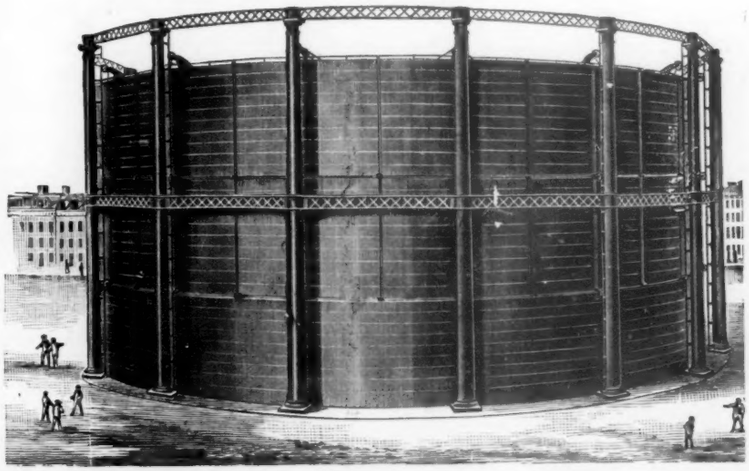

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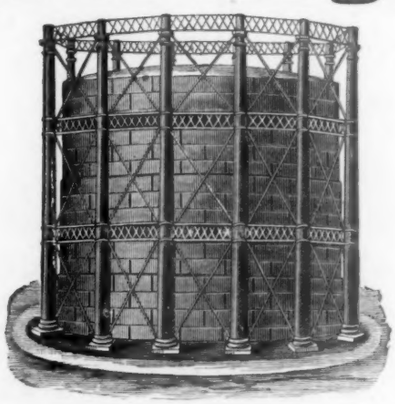

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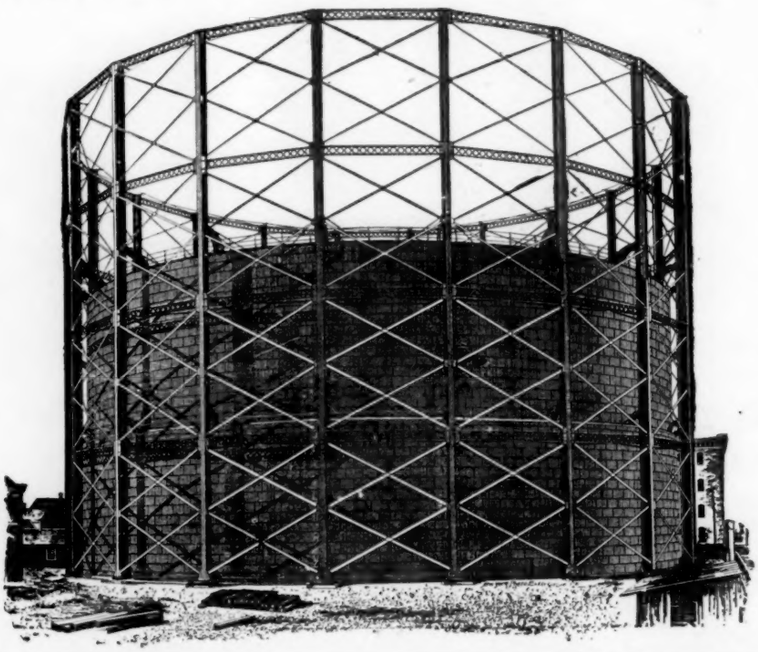

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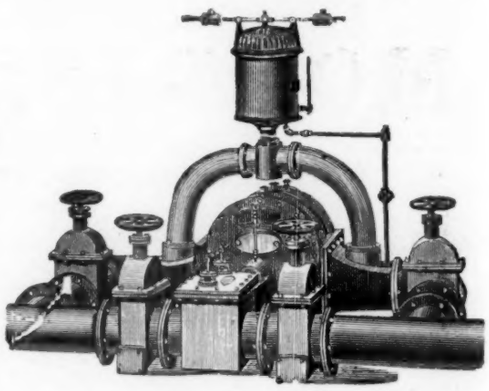

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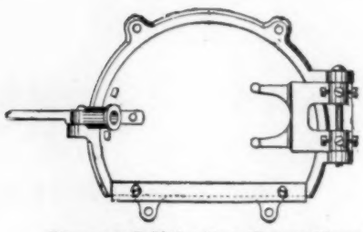

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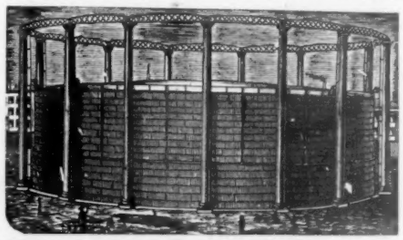

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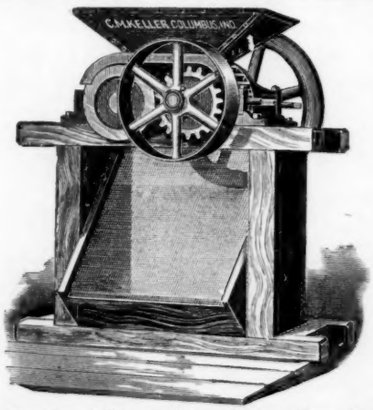

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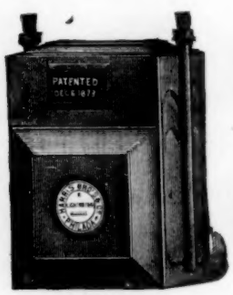

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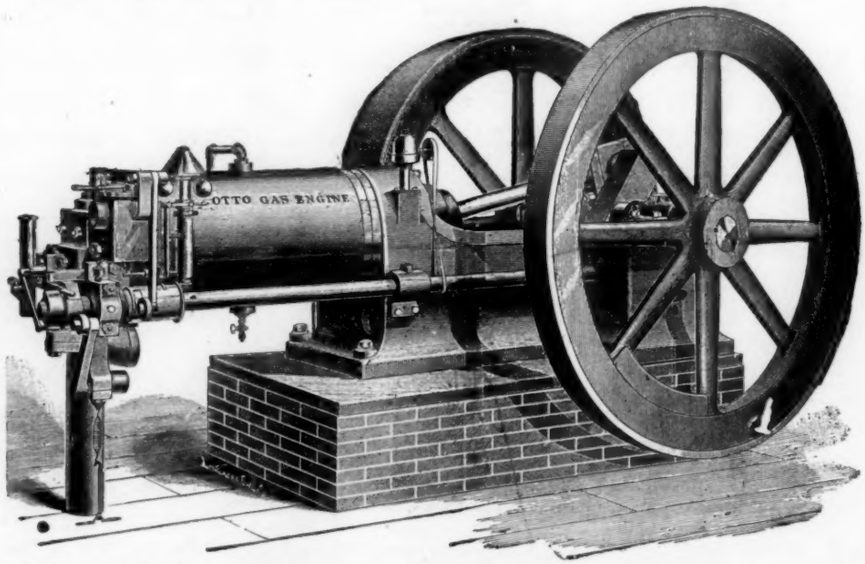

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